

**ECOLOGY OF UNCONSOLIDATED BEACHES
IN LOWER COOK INLET**

by

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TABLE OF CONTENTS

<i>Section</i>	<i>Page</i>
LIST OF FIGURES	465
LIST OF TABLES	467
LIST OF APPENDIXES	469
1. INTRODUCTION	471
2. SUMMARY	474
2.1 Study Sites	474
2.2 Sampling Procedures	475
2.3 General Results and Preliminary Conclusions	475
3. PHYSICAL DESCRIPTIONS OF THE STUDY SITES	482
3.1 General	482
3.2 Sand Beaches - Homer Spit and Deep Creek	483
3.3 Mud Flat at Glacier Spit, Chinitna Bay	484
3.4 Sampling Levels	486
3.5 General Environmental Conditions	488
4. METHODS	491
4.1 Field Procedures	491
4.2 Laboratory Analysis	492
4.3 Numerical Analysis	492
5. RESULTS	494
5.1 Biological Assemblage of the Sand Beach at Deep Creek	494
5.1.1 Zonation	494
5.1.2 Seasonal Patterns	496
5.1.3 Biomass	498
5.1.4 Size Structures	500
5.1.5 Numerical Parameters	502
5.2 Biological Assemblage of the Sand Beach at Homer Spit	506
5.2.1 Zonation	506
5.2.2 Seasonal Patterns	508
5.2.3 Biomass	511
5.2.4 Size Structures	511
5.2.5 Numerical Parameters	512

TABLE OF CONTENTS (continued)

Section	Page
5.3 Biological Assemblage of the Mud Flats at Glacier Spit, Chinitna Bay	516
5.3.1 Seasonal Patterns	518
5.3.2 Zonation	518
5.3.3 Biomass	523
5.3.4 Biology of <i>Macoma balthica</i>	525
5.3.5 Biology of <i>Mya</i> spp.	528
5.3.6 Other Size and Density Data	532
5*3.7 Numerical Parameters	535
6. DISCUSSION . * * O * . . * * * . * * * *	538
6.1 Sand Beach Assemblages	538
6.2 Mud Flat Assemblages	549
6.3 Faunal Composition of Gravel Upper Beaches and Scoured Boulder Fields	556
6.4 Preliminary Discussion of the Potential Effects of Oil Pollution	558
6.4.1 Sand Beaches	560
6.4.2 Gravel and Sand Upper Beaches	561
6.4.3 Scoured Boulder Fields	562
6.4.4 Mud Flats	563
7. LITERATURE CITED	565
APPENDIXES	569

LIST OF FIGURES

<i>Figure</i>	<i>Page</i>
1. Sampling locations in Lower Cook Inlet	474
2. Beach profiles for Deep Creek and Homer Spit	481
3. View of beach at Deep Creek, showing structure of foreshore in 1977	482
4. Estimated beach profile for Glacier Spit, Chinitna Bay	484
5. Length frequency histogram for <i>Eohaustorius eous</i> from DeepCreek, 1977	501
6. Species/area curves for Deep Creek	505
7. Species/area tunes for Homer Spit	515
8. Distribution of major organisms in the faunal assemblage on the mud flat at Glacier Spit, ChinitnaBay	522
9. Several dominant species in the mud flat assemblage at Glacier Spit, Chinitna Bay	523
10. Surface of the mud flat at Bruin Bay in Kamishak Bay, Lower Cook Inlet, showing the porosity as a consequence of biological activity	525
11. Patterns in size, abundance and biomass of <i>Macoma</i> <i>balthica</i> , Chinitna Bay	527
12. Shell length frequency histograms for juveniles of <i>Mya</i> spp. from Glacier Spit, Chinitna Bay , in 1977	530
13. Species/area curves for Glacier Spit, Chinitna Bay	536
14. Generalized food web for sand beaches at Homer Spit andDeepCreek	544
15. Generalized food web for the mud flat at Glacier spit	553

LIST OF TABLES

Table	Page
1. Sediment parameters for sand beach sites in Lower Cook Inlet, May 1978..	476
2* Location and approximate elevation of sampling levels at Homer Spit and Glacier Spit, Chinitna Bay, 1977	478
3. Variation in approximate elevation of sampling levels at Deep Creek in 1977	485
4. Frequency of occurrence of taxa from sandy intertidal sites on the east side of Lower Cook Inlet in 1977	487
5. Period of occurrence of taxa from mud flat at Glacier Spit, Chinitna Bay, in 1977	487
6. Overall density of common species at Deep Creek site	495
7* Important species at each level at Deep Creek	497
8. Distribution of whole wet and estimated dry weights in sample sets at Deep Creek in 1977	499
9. Summary of numerical parameters for the sandy intertidal assemblage at Deep Creek	503
10. Overall density of common species at Homer Spit site	507
11. Important species at each level at Homer Spit	509
12. Distribution of whole wet and estimated dry weights in sample sets at Homer Spit in 1977	510
13. Summary of numerical parameters for the sandy intertidal assemblage at Homer Spit	513
14. Overall density and biomass of common taxa at the Glacier Spit, Chinitna Bay site	517
15. Summary of numerical parameters for the Muddy Bay intertidal assemblage at Glacier Spit, Chinitna Bay	519
16. Important species at each level at Glacier Spit, Chinitna Bay	520

LIST OF TABLES (continued)

<i>Table</i>	<i>Page</i>
17. Summary of biomass data for the mud flat assemblage, Glacier Spit, Chinitna Bay, in 1977	524
18. Distribution of adult and juvenile <i>Mya</i> spp. in the intertidal zone at Glacier Spit, Chinitna Bay	529
19. Distribution and density of adult <i>Mya</i> spp. based on haphazard casts of a 1/16 m ² quadrat	533
20. Density of the basket cockle <i>Clinocardium nuttallii</i> in the intertidal zone at Glacier Spit, Chinitna Bay . .	534
21. Density of the commensal clam <i>Pseudopythina</i> sp. in the intertidal zone at Glacier Spit, Chinitna Bay	534
22. Species composition and density at sand beaches on the east side of Lower Cook Inlet	546
23. Comparison of densities for important species at various sites on unstable sand habitats in Lower Cook Inlet	548

LIST OF APPENDIXES

<i>Appendix</i>	Page
Ia. Abundance data for core samples from Deep Creek beach, 4 February 1977..	569
Ib. Abundance data for core samples from Deep Creek beach, 7 April 1977	571
Ic. Abundance data for core samples from Deep Creek beach, 29 July 1977**	573
IIa. Density of organisms in infaunal samples by level at Deep Creek, 4 February 1977	576
IIb. Density of organisms in infaunal samples by level at Deep Creek, 7 April 1977	577
IIc. Density of organisms in infaunal samples by level at Deep Creek, 29 July 1977...	578
IIIa. Pooled size data for <i>Eohaustorius eous</i> at Deep Creek in 1977	579
IIIb. Length data for unid. Gammaridae with dark eye and coarse antennae, Deep Creek, 29 July 1977	580
IVa. Sample data for Homer Spit beach, 17 February 1977	581
IVb. Sample data for Homer Spit beach, 7 March 1977	583
IVc. Sample data for Homer Spit beach, 28 July 1977	585
Va. Density of organisms in infaunal samples by level at Homer Spit beach, 17 February 1977	588
Vb. Density of organisms in infaunal samples by level at Homer Spit beach, 7 March 1977	589
Vc. Density of organisms in infaunal samples by level at Homer Spit beach, 28 July 1977	590
Via. Abundance data for core samples from the +3.6 foot level at Glacier Spit, Chinitna Bay intertidal area, 6 April 1977.	592
VIIb. Abundance data for core samples from the +3.6 foot level at Glacier Spit, Chinitna Bay intertidal area, 30 July 1977.	596

LIST OF APPENDIXES (continued)

<i>Appendix</i>	<i>Page</i>
VIIa. Biomass data for core samples from Glacier Spit, Chinitna Bay, 6April 1977	603
VIIb . Biomass data for core samples from Glacier Spit, Chinitna Bay, 30 July 1977	609
VIIIa. Summary of density of organisms in infaunal samples by level at Glacier Spit, Chinitna Bay, 6 April 1977	616
VIIIb . Summary of density of organisms in infaunal samples by level at Glacier Spit, Chinitna Bay, 30 July 1977	617
IX. Summary of biomass distribution among organisms and levels at Glacier Spit, Chinitna Bay, in 1977 . .	619
Xa. Shell length data for <i>Macoma balthica</i> from Glacier Spit, Chinitna Bay, 6 April 1977	621
Xb . Shell length data for <i>Macoma balthica</i> from Glacier Spit, Chinitna Bay, 30 July 1977	621
xc. Shell length data for <i>Mya</i> spp. juveniles from Glacier Spit, Chinitna Bay	623
Xd . Shell length and weight measurements for <i>Mya arenaria</i> at Glacier Spit, Chinitna Bay	624
Xe. Shell length and weight measurements for <i>Mya priapus</i> at Glacier Spit, Chinitna Bay	625
Xf . Shell length and weight measurements for <i>Mya truncata</i> at Glacier Spit, Chinitna Bay	626
Xg . Shell length data for <i>Clinocardium nuttallii</i> from Glacier Spit, Chinitna Bay	627
Xh . Shell length and weight measurements for <i>Clinocardium nuttallii</i> at Glacier Spit, Chinitna Bay	628
xi. Shell length data for <i>Pseudopythina</i> sp. from Glacier Spit, Chinitna Bay	629

1. INTRODUCTION

Potential development of oil and gas reserves in Lower Cook Inlet is accompanied by the prospect that the intertidal and shallow subtidal habitats of that estuary may be subjected to large scale chronic or acute contamination. The magnitude of this potential problem is based primarily on the overall importance of this littoral zone and its component habitats to the Inlet and associated systems, and secondarily? on the sensitivity of these habitats to the potential perturbations. Man tends to rank the importance of a resource according to his own observable utilization of the resource. Clamming is the most important human use of intertidal resources in Lower Cook Inlet directly perceived by most individuals, and, since only small segments of the coastline are used, the importance of intertidal habitats is often considered to be low. However, the importance and sensitivity of the zone cannot be evaluated until it has been adequately described and its relationships to other systems are at least generally defined. It is clear from experience in other parts of the world that the greatest observable impacts of oil-related problems occur in the intertidal and nearshore zones.

Intertidal habitats and assemblages in Lower Cook Inlet were generally undescribed until Dames & Moore biologists commenced rocky intertidal studies in Kachemak Bay in 1974 (Dames & Moore, 1976). Soft intertidal habitats (sand and mud) were not studied until spring and summer of 1976, when the Bureau of Land Management (BLM) initiated a reconnaissance of the physical, chemical and biological systems in Lower Cook Inlet through its Outer Continental Shelf Environmental Assessment Program (OCSEAP). These studies were initially designed to collect the information necessary to permit BLM to write the Environmental Impact Statement for the OCS oil and gas lease sale. As part of the recon-

naissance , the first phase of this study (R.U. #417) was designed to examine beaches representative of the major intertidal and shallow subtidal habitats in Lower Cook Inlet (Dames & Moore, 1977).

The intertidal reconnaissance indicated that most of the rocky intertidal habitats in Lower Cook Inlet are located in Kachemak Bay and Kennedy Entrance, on the east, and in Kamishak Bay, on the west. In contrast, the intertidal areas north of Kachemak and Kamishak Bays are mainly soft, with the lower beaches in exposed areas being sand and in protected areas, mud. At lower tidal levels, approximately 50 percent of the shoreline on the west side is mud flats, largely as a consequence of the number of bays that deeply indent into the coastline. North of Kachemak Bay on the east side of the Inlet, the smooth shoreline is interrupted by just a few rivers and streams, and the lower tidal levels are almost exclusively sandy. The upper beaches (above MLLW) for a large proportion of the shoreline in the Lower Inlet are characterized by a steeper slope of coarse gravel and cobbles. Based on the slope, grain size, and impoverished fauna, this habitat appears to be the least stable of the soft, or unconsolidated, intertidal substrates in Lower Cook Inlet.

The reconnaissance study further indicated sharp differences between the biotic assemblages of the sand and mud habitats. Although both habitats are characterized by detritus-based assemblages, and depend to varying degrees upon organic debris produced in other areas, the sand beaches support a rather impoverished assemblage with low biomass whereas the mud beaches support a more diverse assemblage with moderate biomass. The sand beach faunas are dominated by polychaete worms and gammarid amphipods whereas the mud flat faunas are heavily dominated by clams. The lower level of the gravel upper beach appears to be dominated by a

gammarid amphipod and an **isopod**, both of which form dense aggregations under large cobbles (Dames & Moore, 1977) .

It became suspected through the reconnaissance study that intertidal resources are important to several other organisms and systems. For instance, shorebirds, gulls and sea ducks feed heavily on soft intertidal substrates. At least one group is feeding there during each stage of the tide. Fish and crustaceans move into the intertidal zone during high tides to feed and some species remain there during low tide (Green 1968) . Several investigators have reported that mud flats are important feeding areas for juvenile salmon (Sibert et al. 1977; Kaczynski et al. 1973).

However, only preliminary descriptions of the various systems examined were provided. The major objective of the research described in this report was to more fully describe the systems at specific sites, and identify the more important relationships and processes operating in these assemblages. This necessitated a fairly detailed examination of seasonal changes in species composition and structure. Trophic relationships were not emphasized because the most important predators (birds and fish) are the object of other research units.

2.2 SAMPLING PROCEDURES

The field studies initiated at these sites were designed to determine species composition, zonation, and seasonal changes, and to develop preliminary estimates of secondary productivity. The nucleus of the experimental design was seasonal collection of replicate core samples of the sediment and associated infauna at several lower intertidal levels on each beach. These samples provided the basic data describing the assemblages on sand and mud beaches. Relationships between these and other assemblages have been determined through examination of the literature, discussions with other investigators, and direct observation.

2.3 GENERAL RESULTS AND PRELIMINARY CONCLUSIONS

At the two sand beaches and the mud flat studied the respective faunas were distinctly different. Sampling efforts were essentially equal in each survey. Twenty-two species were identified from the sand beach at Deep Creek (Table 1), where the fauna was dominated by the gammarid amphipod Eohaustorius eous. Thirty species were identified from the sand beach at Homer Spit (Table 1), where the fauna was dominated by the polychaete Scolelepis sp. A. Forty species were identified from the mud flat at Chinitna Bay (Table 2), where the fauna was dominated by the clams Macoma balthica, Mya arenaria, M. truncata and Mya priapus. Mya spp. are possibly present at commercially harvestable densities. Although unmeasured, the mud flat also supported appreciable standing crops of benthic diatoms and filamentous brown and green algae in the summer. These differences reflect considerable differences in physical conditions and productivity.

Zonation of the biological assemblages was readily apparent in the distribution of species abundance but gener-

TABLE 1. FREQUENCY OF OCCURRENCE OF TAXA FROM SANDY INTERTIDAL SITES ON THE EAST SIDE OF LOWER COOK INLET IN 1977

<u>Taxa</u>	<u>Deep Creek</u>	<u>Homer Spit</u>
PLATYHELMINTHES		
<u>Turbellaria</u> , unid.	0	1
ANNELIDA - Polychaeta		
<u>Abarenicola</u> sp.	1	0
<u>Capitella</u> <u>capitata</u>	3	1
<u>Chaetozone</u> <u>setosa</u>	1	0
<u>Eteone</u> nr. <u>longs</u>	3	2
<u>Magelona</u> <u>pitelkae</u>	0	1
<u>Nephtys</u> ? <u>ciliata</u>	2	3
<u>Nephtys</u> sp. (juv.)	0	1
<u>Paraonella</u> <u>platybranchia</u>	3	3
Sabellidae, unid.	0	1
<u>Scolelepis</u> p. A	3	3
<u>Scoloplos</u> <u>armiger</u>	3	1
Spionidae, unid.	0	1
<u>Spiophanes</u> ? <u>bombyx</u>	0	1
<u>Typosyllis</u> sp.	0	1
ARTHROPODA - Crustacea		
<u>Anisogammarus</u> cf. <u>confervicolus</u>	2	
<u>Archaeomysis</u> <u>grebnitzkii</u>	2	

<u>Taxa</u>	<u>Deep Creek</u>	<u>Homer Spit</u>
<u>Atylidae, sp.A</u>	1	0
<u>Crangon ?alaskensis elongatus</u>	0	1
<u>Eohaustorius eous</u>	3	3
Gammaridae sp.A	1	0
Gammaridea, red striped	0	1
<u>Lamprops carinata</u>	0	1
<u>Lamprops quadriplicata</u>	1	1
<u>Lamprops sp.</u>	0	1
Lysianassidae, unid.	1	2
Oedocerotidae, unid.	1	0
<u>Paraphoxus milleri</u>	1	2
<u>Paraphoxus sp.</u>	2	1
<u>Synchelidium sp.</u>	1	0
MOLLUSCA - Gastropoda		
<u>Littorina sitkana</u>	0	1
MOLLUSCA - Pelecypoda		
<u>Mytilus edulis</u>	0	1
<u>Protothaca staminea</u>	0	1
<u>Spisula polynyma</u>	0	3
CHORDATA - Pisces		
<u>Ammodytes hexapterus</u>	0	3
Total Number of Species	22	30

TABLE 2. PERIOD OF OCCURRENCE OF TAXA FROM MUD FLAT SITE AT GLACIER SPIT, CHINITNA BAY IN 1977

TAXON		TAXON	
NEMERTEA, unid.	7 ^a	ARTHROPODA	
ANNELIDA		Atari.na, unid.	7
<u>Abarenicola pacifica</u>	4	Cyclopoida, unid.	7
<u>Ampharete acutifrons</u>	4,7	Crangon sp	7
<u>Aphroditoidea, unid</u>	4	Harpacticoida, unid.	7
<u>Axiothella rubricincta</u>	7	Insects (larva)	7
<u>Capitella capitata</u>	4,7	Ischyrocerodidae, unid.	7
<u>Eteone nr. longa</u>	4,7	<u>Pontoporeia femorata</u>	7
<u>E. nr. pacifica</u>	7	<u>Saduria entomon</u>	4
<u>Glycinde polyqnatha</u>	4	<u>Tritella ?pilimana</u>	4,7
<u>Harmothoe imbricata</u>	4,7	MOLLUSCA	
<u>Malacoceros sp</u>	4,7	<u>Aglaja diomedea</u>	7
<u>Maldanidae, unid.</u>	7	<u>Clinocardium nuttallii</u>	4,7
<u>Nephtys sp</u>	4,7	<u>Cylichna sp</u>	7
<u>Nephtys sp (juvenile)</u>	4,7	<u>Macoma balthica</u>	4,7
<u>Oligochaeta, unid.</u>	7	<u>Macoma sp</u>	4
<u>Paraonella platybranchia</u>	7	<u>Mya arenaria</u>	4,7
<u>Paraonidae, unid.</u>	4	<u>M. priapus</u>	4,7
<u>Phyllodoce groenlandica</u>	4,7	<u>M. truncata</u>	4,7
<u>Polydora caulleryi</u>	4,7	<u>Mya spp. (juveniles)</u>	4,7
<u>Polygordius sp</u>	7	<u>Pseudopythina sp</u>	4,7
<u>Potamilla sp</u>	4,7		
<u>Scoloplos armiger</u>	4,7		
<u>Spio ?filicornis</u>	7		
<u>?Spio sp</u>	4		
<u>Spionidae, unid.</u>	7		
ECHIURA			
<u>Echiurus echiurus</u>			
<u>alaskensis</u>	4,7		

^a Number refers to month of sampling period; 4 = April, 7 = July

ally not apparent in species composition. Many of the species were more abundant at the lower tidal levels.

Most of the species exhibited considerable seasonal changes in abundance. Generally, polychaete worms and amphipods were more abundant in summer, but clams were most abundant in spring. Juveniles of several species appeared in the samples only in the summer, a relatively mild period.

In addition to the strong differences in faunal composition noted above, appreciable differences were observed in species richness, biomass, and age structure. The mud flat assemblage had appreciably higher species richness and diversity, higher biomass (about 3000 g/m² compared to about 20 g/m² on sand), and most species in the mud fauna are perennials living over five years, in contrast to the predominance by annual species on sand beaches. These characteristics indicate that the mud flat assemblage is somewhat more complex and highly developed than the sand beach assemblages.

Evaluation of the trophic structures of these assemblages indicates that all are based on detritus. The great majority of the organisms are deposit feeders or suspension feeders. Resident predators are uncommon. Feeding observations suggest that a large proportion of the animals living in these habitats are eaten by transient predators from other assemblages and geographic areas. Some of the important groups that forage heavily in these habitats include crabs, fish (e.g., flatfish, cottids and juvenile salmon), shorebirds, and diving and dabbling ducks. Qualitative impressions of exploitation levels suggest that the mud flat assemblage is utilized much more heavily than the sand beaches. A comparison of abundance, biomass and growth data seems to support this hypothesis. Several bird species (e.g., Western Sandpipers and Dunlins) seem parti-

cularly dependent on mud flat assemblages during spring migration. Greater **Scaup**, Oldsquaw, Surf **Scoters** and Black **Scoters** feed extensively on mud flats in the winter.

These biological descriptions are crucial in arriving at several useful preliminary conclusions. First, combining the biological attributes and contributions of the various assemblages with predicted ranking of various substrates to hydrocarbon uptake, storage and retention characteristics (based on **geomorphological** considerations and field observations at major oil spill sites, as described by Hayes et al., 1977), it appears that mud flats are the most sensitive of the substrates examined in this study to contamination by crude oil. Furthermore, based on the high probability that: a) Much of the seemingly high productivity of mud flats is used by animals from other systems, and b) that mud flats are very important to a number of marine and terrestrial animals (some commercially important and others migrating across broad geographic ranges) , the importance of protecting this habitat from pollution is quite obvious. Second, because of the concentration of sand beaches in the northeastern quadrant of Lower Cook Inlet, and of mud flats in Kachemak Bay and on the west side of the Inlet, the most acceptable location for development of onshore facilities, in biological terms, is between Anchor Point and Nikiski.

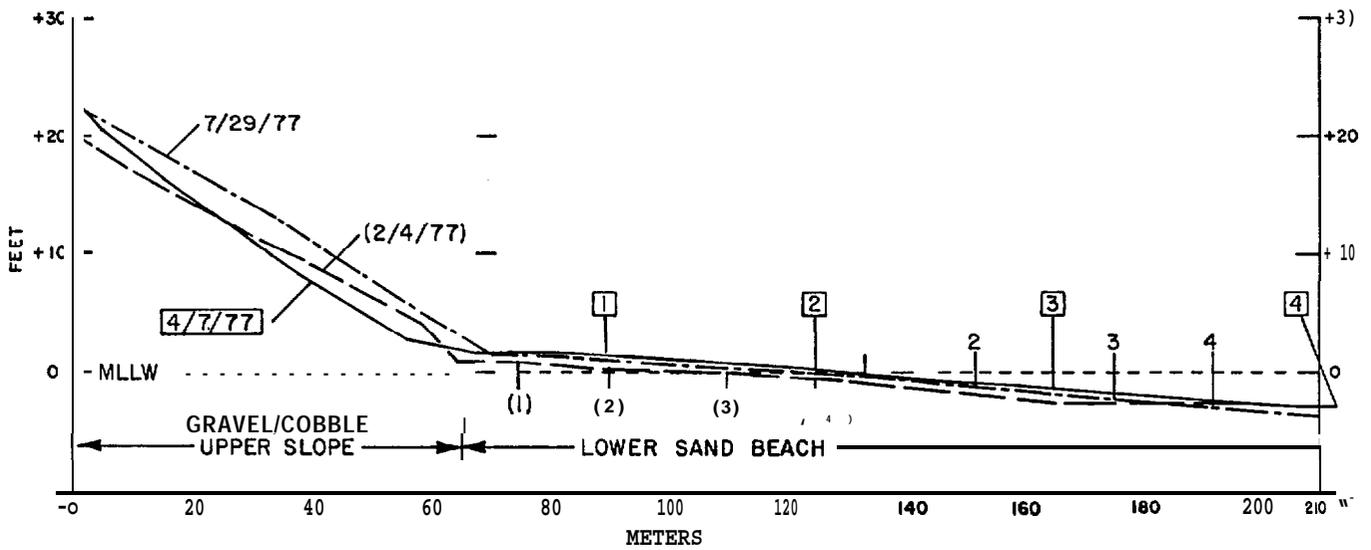


FIGURE 2A - BEACH PROFILES FOR DEEP CREEK

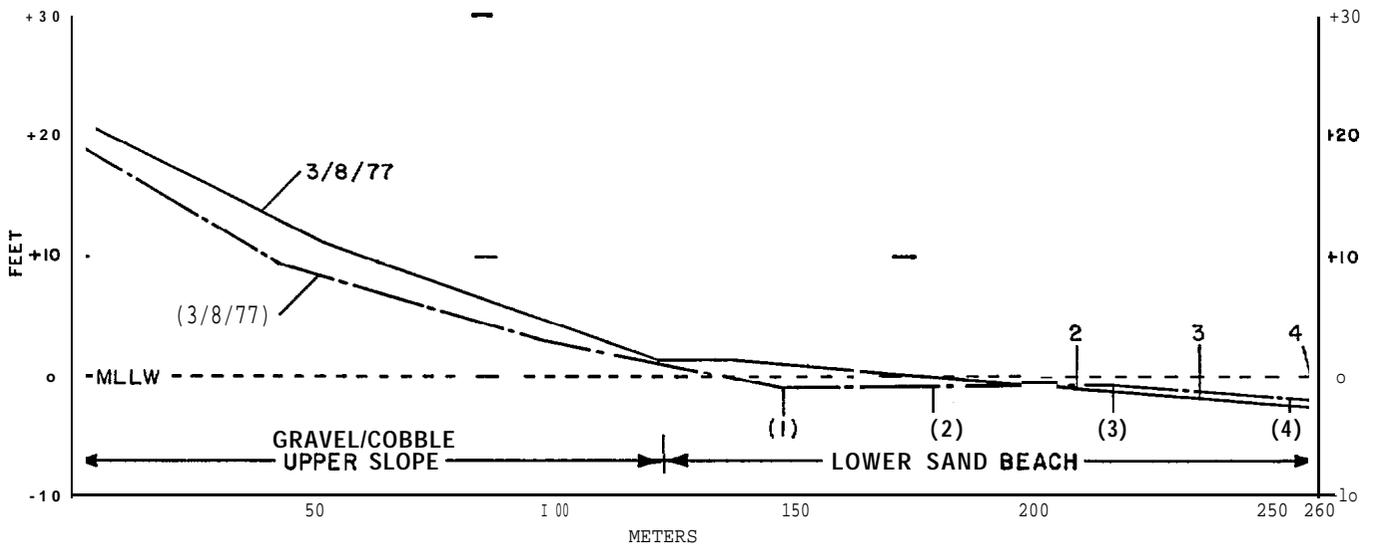
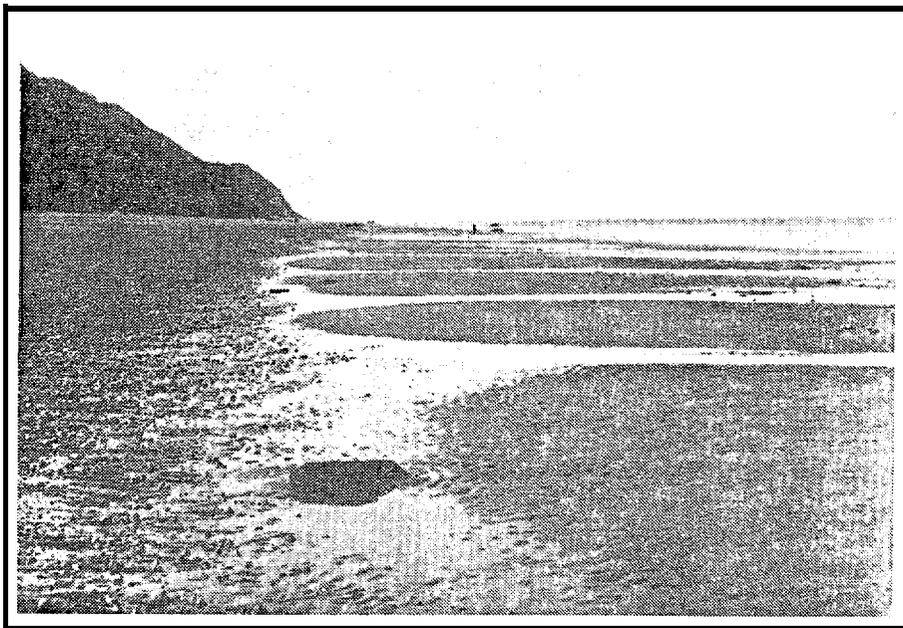


FIGURE 2B - BEACH PROFILES FOR HOMER SPIT

3. PHYSICAL DESCRIPTION OF THE STUDY SITES

3.1 GENERAL

Hayes et al. (1977) provides useful characterizations of numerous beaches on both sides of Lower Cook Inlet. Most of the beaches from Kachemak Bay north, on the east side of the Inlet, are characterized by a narrow, fairly steep, unstable, gravel beach face extending down to an elevation of from about two feet to MLLW and a broad, flat, more consolidated fine sand low-tide terrace extending out into the subtidal zone (Figure 2). The boundary between the gravel and sand facies is generally sharply demarcated by changes both in slope and substrate. However, in some locations, it is interrupted by a narrow band of small boulders. In many instances, a small water-filled trough also occurs at the boundary, apparently as a consequence of the water draining out of the gravel slope above. This trough produces small drainage channels running perpendicularly to the shoreline at intervals along the beach (Figure 3).



**FIGURE 3 - VIEW OF BEACH AT DEEP CREEK,
SHOWING STRUCTURE OF THE FORESHORE IN 1977**

3.2 SAND BEACHES - HOMER SPIT AND DEEP CREEK

The sandy beaches are located on the east side of Lower Cook Inlet (Figure 1) . Both were selected for accessibility. Based on his razor clam surveys, Mr. David Nelson, ADF&G (personal communication) , indicated that the Deep Creek site, 1.5 miles south of the beach park, is fairly representative of beach conditions between Anchor Point and Clam Gulch. The base point for the transect is a room-sized triangular boulder at the base of the bluff (an erosional scarp) . We selected the Homer Spit site, 2.5 miles south of the Kachemak Drive, because it appeared to support a richer fauna and higher standing stock than the Deep Creek site.

Corrected beach profiles for the Deep Creek and Homer Spit sites (Figure 2) provide two important pieces of information. First, it appears that the shape of the beaches change very little seasonally compared to beaches exposed to the open ocean (Bascom, 1964).

However, because of large inaccuracies in the original profile data, the accuracy of the corrected profiles is undetermined. Our notes and recollections of fixed features on the beach lead us to accept the general shape of the profiles, but to question the changes recorded for the gravel upper slopes at both sites.

Second, the gravel upper beach is considerably steeper at Deep Creek than at Homer Spit. According to Bascom (1964) this indicates that the beach at Homer is somewhat less exposed than at Deep Creek. Shepard (1963) also points out that the beach at Homer should be coarser and more porous.

Based on sediment samples collected at two levels from both lower beaches, sediment conditions are quite

similar (Table 3) . The sand may be slightly coarser at Homer Spit than at Deep Creek. The sediment in both areas is a moderate to well-sorted fine to medium sand with a significant quantity of small gravel; fine sand was mainly found at the lower levels. Also, thin strata of pulverized coal were common at both beaches. Evidence of anoxic conditions (blackened sand or sulfide odor) was lacking at both sites.

3.3 MUD FLAT AT GLACIER SPIT, CHINITNA BAY

The mud beach study site is adjacent to the Byer homestead, on Glacier Spit, Chinitna Bay, on the west side of the Inlet. It was chosen because it is a typical mud flat, and has a year-round resident and shelter. The base point for the transect is a solitary group of large boulders at the border between the gravel upper slope and the mud low-tide terrace.

The basic structure of the beach at the Chinitna site is similar to that described for the two sand beaches (Figure 4). An important difference is the flatter slope of the mud flat. However, the slope of the gravel upper beach at Glacier Spit is steeper than at either sand beach site.

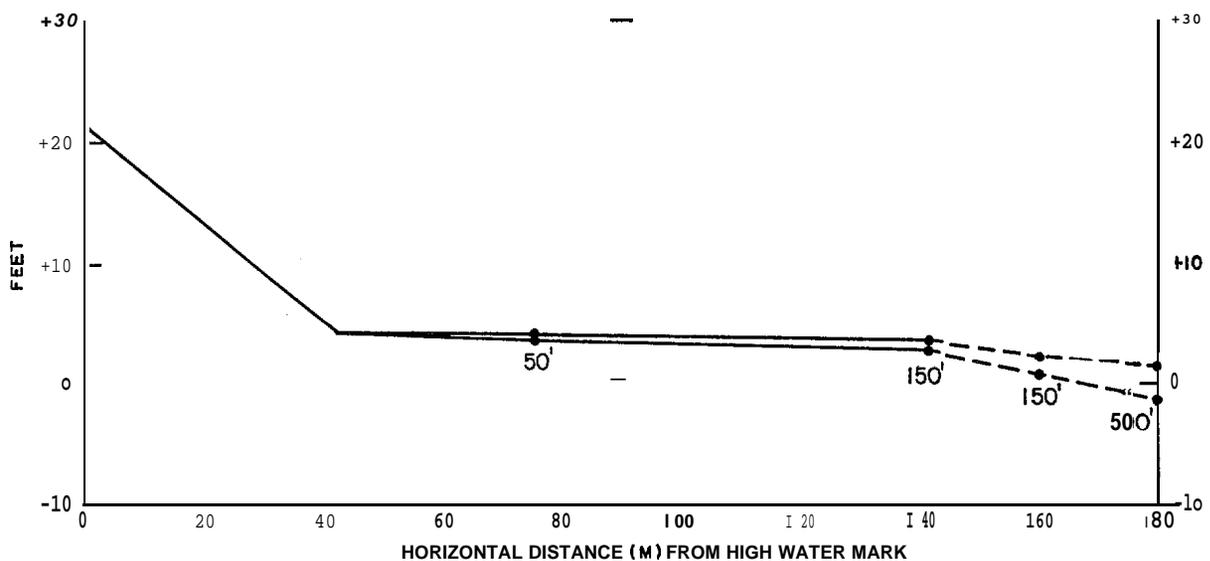


FIGURE 4- ESTIMATED BEACH PROFILE FOR GLACIER SPIT, CHINITNA BAY

TABLE 3. SEDIMENT PARAMETERS FOR SAND BEACH SAMPLING SITES
IN LOWER COOK INLET, MAY 1978

Location	Grain Size		Dispersion	
	M_d (mm)	M (mm)	$\sigma\phi$	$\alpha\phi$
Homer Spit - 30m level				
Replicate 1	0.24	0.24	0.39	0.06
2	0.28	0.28	0.54	0.04
3	0.35	0.41	0.70	-0.31
\bar{x}	0.29	0.31	0.54	-0.07
s	0.06	0.09	0.16	0.20
Homer Spit - 135m level				
Replicate 1	0.21	0.22	0.45	-0.14
2	0.25	0.25	0.56	-0.01
3	0.22	0.24	0.57	-0.19
\bar{x}	0.23	0.24	0.53	-0.11
s	0.02	0.02	0.07	0.09
Deep Creek - Level 1				
Replicate 1	0.26	0.27	0.50	-0.10
2	0.28	0.28	0.45	0.01
3	0.24	0.25	0.56	-0.17
\bar{x}	0.26	0.27	0.50	-0.09
s	0.02	0.01	0.06	0.09
Deep Creek - Level 3				
Replicate 1	0.22	0.21	0.40	0.06
2	0.21	0.20	0.48	0.05
3	0.21	0.20	0.42	0.06
\bar{x}	0.21	0.20	0.43	0.06
s	0.01	0.01	0.04	0.01

Sediment samples from Glacier Spit have not yet been processed. However, the sediment is basically a sandy silt with appreciable clay. It appears to be moderately well consolidated. Evidence of anoxic conditions (blackened sediment and shells, odor of sulfides) occur within 10 cm of the surface.

3.4 SAMPLING LEVELS

At the Homer Spit and Chinitna Bay sites, the sampling levels were established at predetermined distances from the gravel-sand interface. The location of these levels and their approximate elevations are indicated in Table 4.

At the Deep Creek site, we attempted to locate the levels according to predetermined elevations, specifically, **MLLW**, -1, -2 and -3 feet below **MLLW**. This was not successful because of the various sources of error inherent to the surveying method used and the unreliable or incomplete nature of the tidal information upon which we operated. The approximate elevations sampled at Deep Creek are indicated in Table 5.

On the sand beaches, neither of these methods of relocating sampling levels was completely satisfactory but the method used on the mud flat was satisfactory. A major technical problem on sand beaches is that the movement of the sand associated with changes in profile or elevation will cause some animals (e.g. , amphipods) to relocate quickly to a suitable elevation but others such as deep-burrowing **polychaetes** cannot respond rapidly. Therefore, sampling at a set distance from a known point permits reasonable samples of **polychaete** populations, but any seasonal changes in elevation may cause problems for sampling amphipods. On the other hand, sampling at pre-determined elevations appears

TABLE 4. LOCATION AND APPROXIMATE ELEVATION OF SAMPLING LEVELS AT HOMER SPIT AND GLACIER SPIT, CHINITNA BAY, 1977.

Sampling Level	<u>Homer Spit</u>		<u>Glacier Spit, Chinitna Bay</u>		
	Distance from Interface (meters)	Approximate Elevation (feet)		Distance from Interface (meters)	Approximate Elevation (feet)
		3/8/77	7/28/77		
1 (Upper)	30	+0.75	-1.0	50	3.8 to 3.6
2	75	-0.75	-0.75	150	3.25 to 2.5
3	100	-1.75	-0.5	350	2.1 to 0.9
4 (Lower)	135	-2.5	-1.5	500	1.3 to -1.2

TABLE 5. VARIATION IN APPROXIMATE ELEVATION (FEET) OF SAMPLING LEVELS AT DEEP CREEK IN 1977.

Sampling Level	2/4/77	4/7/77	7/29/77
1 (Upper)	+1.0	+1.5	0.0
2	+0.5	+0.5	-1.0
3	0.0	-1.25	-2.0
4 (Lower)	-0.5	-2.75	-2.75

difficult to accomplish and also can result in large differences in the horizontal position of sequential sample sets at the same level. This would preclude sampling the same **polychaete** populations.

A completely satisfactory solution to this problem seems unlikely. However, based on the preliminary information that seasonal changes in the beach profiles are small, it seems most acceptable to sample at given distances from a fixed feature on the beach.

3.5 GENERAL ENVIRONMENTAL CONDITIONS

A comparison of environmental conditions at the **three** sites reveals some distinct differences. The factors considered are sediment **temperature**, ice cover and **scour**, salinity, turbidity, wave action and tidal currents. The comparisons are qualitative and frequently based on inference.

Severe winter air temperatures are somewhat lower at Chinitna Bay and Deep Creek than at Homer Spit. Surface sediment temperatures at the Spit are probably less severe during night low tides than at the other two sites. Chinitna Bay may also experience stronger winds than the other sites, causing greater wind chill effects. The surface layer of sediment freezes at all three sites during low tides in late fall and winter, but our impression is that it freezes deeper at Chinitna.

The scouring effects of sea ice range from **substantial** at Chinitna to low at both Deep Creek and Homer Spit. Wayne **Byer**, a resident on Glacier Spit, reports that during winter low tides, thickness of stranded ice approaches 2 m opposite his homestead (personal communication) . In contrast, stranded ice blocks are not common at either of the sand beaches, but can occur during harsh winters. Floe

ice at Glacier Spit may protect the sediment from extremely low temperatures in many cases, but can scour extensively.

Based on location, it would appear that salinity would be highest, and least variable, at Homer Spit, and lowest and most variable at Glacier Spit, which is essentially estuarine and situated in a bay near a number of streams. This inference is supported by the salinity patterns described by Kinney et al. (1970).

Our observations indicate that turbidity (suspended solids) is lowest, but highly variable, at Homer Spit, and highest and least variable at Glacier Spit. This agrees with the basic pattern reported by Sharma et al. (1974) .

Wave action is a powerful influence at both Homer Spit and Deep Creek. Homer Spit has a maximum fetch for direct wind waves of 100 miles, and is only slightly protected from waves generated in Skelikof Straits. Breakers up to 2.5 m high have been observed there, and Hayes et al. (1977) predicts 3 m. However, Homer Spit is generally protected from northerly storms. Although Deep Creek is exposed to waves from south, west and north, and so is probably disturbed by wave action more regularly, the maximum fetch for direct waves is only about 30 miles. Because the stronger north and south waves will approach at an oblique angle, their force will be greatly reduced. Glacier Spit is generally protected from all but waves from the southeast, and surf over 1 m high is probably rare.

The influence of tidal currents varies greatly among the three sites. Exposure is greatest at Deep Creek, as it is located directly on the shoreline of the Inlet. The Homer Spit site is only slightly affected by tidal currents because of the protection provided by the Spit,

particularly during outgoing tides. Glacier Spit, located near the head of Chinitna **Bay**, is subjected to only minimal tidal currents.

The differences in exposure to wave action and tidal currents are clearly reflected in the contrasting sediment regimes at Homer Spit and Deep Creek, on one hand, and Glacier Spit, on the other. Furthermore, slope of the upper beach indicates that Homer Spit **is** exposed to heavier surf; fall storms are particularly strong. However, tidal currents are stronger **at** Deep Creek and occur four times daily, so their overall effect may be greater.

4. METHODS

4.1 FIELD PROCEDURES

A stratified random sampling design was employed to examine the infauna of sand beaches at Homer Spit and Deep Creek, and the mud flat at Glacier Spit, Chinitna Bay. A transect extending across the beach from a specified point was established on each beach. Samples were collected at four specified levels or distances from the base of each transect. At each level, a measured line was laid out parallel to the shoreline and a set of vertical core samples was collected at random points along that line. All sample sets included ten replicate cores per level, except that only five per level were collected at Homer Spit in February 1977. The core sample collected was 10 cm in diameter (78.5 cm^2) by 30 cm in length (2356.2 cm^3). Each core sample was placed in a separate polyethylene bag and labelled. Subsequently, the core samples were sieved through a 1.0 mm screen to reduce the amount of inorganic material and the sample rebagged and preserved with a 10 percent formaldehyde-sea water solution.

Approximate beach profiles were determined using a measured PVC stadia rod, an expedient monopod and a telescopic level. Starting at the drift line of the previous high tide (estimated from the litter line and sediment dampness) a measured line was extended across the intertidal zone to the lower water line at low slack tide. Profile data were acquired by determining elevation changes over a measured horizontal ground distance with the level and stadia rod. Profile data were collected from high water to low water and back to high water; plotted profiles were averages of the two.

This method is subject to several inaccuracies. It is based on the accuracy of the published tide informa-

tion on time and changes. Therefore, meteorological phenomena and correction factors are important sources of error.

4.2 LABORATORY ANALYSIS

In the laboratory each core was rough sorted under a dissecting microscope to separate the animals from the remaining sediment and to divide them by major **taxa**, mainly **polychaete** worms and crustaceans. At this time they were placed in a 30 percent isopropyl alcohol preservative. Subsequently, the samples were examined to identify the species and count the individuals. Initially, **all** specimens were also sent to taxonomic specialists to verify or obtain identifications. Subsequently, only difficult species have been sent out. The specialists consulted were: Bruce Benedict, formerly of Marine Biological Consultants, Inc., for gammarid **amphipods**, and Rick Rowe, **Allan Hancock Foundation**, University of Southern California, for **polychaetes**.

Following identification, the samples were re-examined to obtain length and weight data. Lengths of gammarid **amphipods** and small clams were measured on a dissecting microscope equipped with an ocular micrometer. **Whole** wet weights of animals were obtained by draining the specimens for about 15 seconds on damp paper towels and weighing them on a Torsion DWM2 balance accurate to ± 5 mg.

4.3 NUMERICAL ANALYSES

Quantitative samples (cores) produced several numerical parameters useful in describing and comparing **faunal** assemblages. Used to describe abundance were 1) the total number of specimens per level (N) , 2) the average number of specimens per core sample (\pm one standard deviation) , and 3) the number of organisms per m^2 . Species richness was described with 1) the total number of species

per level (S) , 2) the average ($\pm s$) number of species per core, and 3) the Brillouin diversity index $[H = 1/N (\log_2 \frac{N!}{n_1!n_2! \dots n_j!})]$, where $n_1, n_2 \dots n_j$ are the number of individuals in species 1 through j]. The equitability, or evenness of the distribution of specimens among species was described by N/S and E , which was defined as H/S . Standard deviations are included to provide an indication of variability among the samples.

In addition, species-area curves were constructed to demonstrate the rate at which species were accrued within the assemblage observed at each level. This technique provided additional insight into the adequacy with which a level, or the area, was sampled.

To assist in describing zonation on the sand beaches, the abundance of each species was compared among levels to determine distribution patterns and composition at each elevation. Species that occurred at a given level in all three surveys and had a density exceeding $100/m^2$ at least once were categorized as "Dominants". "Subdominants" also occurred in each survey but their density never exceeded $100/m^2$. Species that occurred in only two surveys were categorized as "Frequent", regardless of density, and those that appeared only once, but at a density exceeding $100/m^2$, were considered "Seasonal". The categories for the mud beach, where data for only two surveys are included, are somewhat different. Species that occurred at a given level in both surveys and for which density exceeded $100/m^2$ at least once were categorized as "Dominant". "Subdominant" also occurred in both surveys but ranged between $100/m^2$ and $10/m^2$ in both surveys. Those which occurred in both surveys with densities ranging between $5/m^2$ and $10/m^2$ at least once were classified as "Frequent". Finally, species that occurred only once at densities of greater than $20/m^2$ were designated as "Seasonal".

5. RESULTS

5.1 BIOLOGICAL ASSEMBLAGE OF THE SAND BEACH AT DEEP CREEK

The infaunal assemblage at the Deep Creek site was sampled three times during the period covered by this report, namely on 4 February, 7 April and 29 July 1977. A total of 17 taxa, including eight polychaete and nine crustacean taxa, was identified during the sampling period (Table 1).

Quantitatively, the infauna was dominated heavily by gammarid amphipods, especially the haustoriid Eohaustorius eous (Table 6). Relative abundance was remarkably uniform seasonally. An unidentified member of the amphipod family Gammaridae (Gammaridae sp. A) was quite abundant in the July survey. The remaining species were only of marginal numerical importance. Most notable among these were the polychaetes Eteone nr. longs and Scoelelepis sp. A, and the gammarid Paraphoxus milleri. The raw data for these samples, by core, level and survey, are presented in Appendix I and species summaries in Appendix II.

5.1.1 Zonation

To examine zonation, the species at each level were assigned, by survey, to "importance" categories according to their density and frequency of occurrence (see METHODS section). Species composition was then compared among the sampling levels. According to these criteria, the upper level was dominated by Eteone and Eohaustorius, the middle

TABLE 6. OVERALL DENSITY (NO. /M²) OF COMMON SPECIES AT DEEP CREEK SITE

Taxa	<u>2/77</u> Density	<u>%</u>	<u>4/77</u> Density	<u>%</u>	<u>7/77</u> Density	<u>%</u>
Polychaeta		(17.6)^a		(12.9)		(13.4)
<u>Capitella</u> ? <u>capitata</u>	9.6	1.8			9.6	0.8
<u>Eteone</u> nr. <u>longa</u> ^b	44.6	8.6	9.6	1.6	9.6	0.8
<u>Nephtys</u> ? <u>ciliata</u> ^b			9.6	1.6	9.6	0.8
<u>Paraonella</u> <u>platybranchia</u>	15.9	3.0	9.6	1.6	12.7	1.0
<u>Scolelepis</u> sp. A ^b	15.9	3.0	35.0	5.4	92.3	7.4
<u>Scoloplos</u> <u>armiger</u> ^b	6.4	1.2	15.9	2.7	31.8	2.6
Gammaridea		(81.3)		(84.7)		(84.6)
<u>Anisogammarus</u> cf. <u>confervicolus</u>	6.4	1.2	6.4	1.0		
<u>Eohaustorius</u> <u>eous</u>	404.2	78.3	461.5	78.8	648.4	51.9
Gammaridae, sp. A					388.3	31.2
<u>Paraphoxus</u> <u>milleri</u> ^b	9.6	1.8	28.6	4.9	19.1	1.5
Mysidacea						
<u>Archaeomysis</u> <u>grebnitzkii</u>	3.2	0.6			3.2	0.2

^a Parenthetic number are total percentages in major taxa

^b Also common in **sandy infaunal** samples collected at 200 ft. depths in the middle of Lower Cook Inlet and at Homer Spit

^c Also found at Homer Spit

two levels by Eohaustorius and the lower level by Scoelelepis and Eohaustorius (Table 7) . Only the latter species was important at all levels.

The relationship between elevation and density was examined, but only the increase of Eohaustorius at lower elevations departed significantly from random ($P < 0.02$) . In contrast, Eteone was more abundant at the upper levels than below, but the pattern was not statistically significant. In addition, densities in July appeared to be quite variable for several species. It appears that the middle level is near the upper limit for Scoelelepis and Paraphoxus at this beach. The paucity of statistically significant elevation-related density differences among the species observed is probably mostly a consequence of too few samples, or a high degree of patchiness, as well as the changes in the beach shape and the corresponding movement of the animal populations in relation to the sampling levels.

Field observations indicate patterns of vertical distribution in the sediment for some of the species. All of the gammarid amphipods appear to live within 5 cm of the water-sand interface. On the other hand, the polychaetes Scoelelepis and Nephtys are generally encountered at least 15 cm below the interface during low tides.

5.1.2 Seasonal Patterns

Several seasonal patterns were apparent. Overall density increased from February to July (Table 6). Within this general pattern, two trends were discerned. Ganunaridae

TABLE 7. IMPORTANT SPECIES AT EACH LEVEL AT DEEP CREEK

Species	1	Sampling 2	Level 3	4
Polychaetes				
<u>Capitella</u> <u>capitata</u>		Frequent		
<u>Eteone</u> nr <u>longa</u>	Dominant	Frequent		
<u>Paraonella</u> <u>platybranchia</u>		Frequent	Sub- dominant	Frequent
<u>Scoelepis</u> sp. A		Seasonal	sub- dominant	Dominant
<u>Scoloplos</u> <u>armiger</u>			sub- dominant	Frequent
Crustaceans				
<u>Anisogammarus</u> cf <u>confervicolus</u>	Frequent			Frequent
<u>Eohaustorius</u> <u>eous</u>	Dominant	Dominant	Dominant	Dominant
Gammaridae sp. A		Seasonal	Seasonal	Seasonal
<u>Paraphoxus</u> <u>milleri</u>		Frequent	Sub- dominant	Sub- dominant

sp. A increased strongly in abundance during the summer. Several other species, i.e., Eohaustorius and the polychaetes Scoelelepis and Scoloplos, increased during the survey, but not significantly (respectively, $P > 0.65$, > 0.05 and > 0.20 , based on a Friedman X^2 analysis of variance computed with pooled data for each level and tested among surveys). In contrast, Eteone nr. longs decreased in abundance but not significantly ($P > 0.05$). These trends appear strong and the lack of significance appears to be mainly a consequence of too few samples.

5.1.3 Biomass

In terms of biomass, the fauna at Deep Creek was generally dominated by polychaetes in April but by gammarid amphipods in July (Table 8). Specifically, in order of importance, the dominant polychaetes were Scoloplos, Eteone, Nephtys and Scoelelepis in April, and Scoloplos, Scoelelepis, Nephtys and Abarenicola in July. Dominant gammarids were Eohaustorius in April, and in July, Gammaridae sp. A and Eohaustorius. Overall, Eohaustorius dominated in terms of biomass in April and Gammaridae sp. A in July; Eohaustorius was next most important in July.

Generally, biomass levels were relatively low and consequently strongly affected by large, uncommon species such as Nephtys, or spatially and temporally patchy species such as Gammaridae sp. A. However, two general trends appeared real. During both surveys, there was a tendency for biomass to be greater at lower levels, mainly reflecting the patterns of the dominant species. Furthermore, there

TABLE 8. DISTRIBUTION OF WHOLE WET AND ESTIMATED DRY WEIGHTS IN SAMPLE SETS AT DEEP CREEK IN 1977 (WEIGHTS IN RAM

Level	SURVEY LOGS				Survey Total							
	April	Wet	Dry	July	Wet	Dry						
Polychaeta	0.360) ^a	0.010	0.120	(0.444)	0.934	(0.155)	0.64	0.41	(0.324)	0.388	1.417	0.221)
<u>Abarenicola pacifica</u>	0	0	0	0	0	-	0	0.127	0	0	0.127	0.027
<u>Capitella capitata</u>	0	0	0	0	0	-	0	0.027	0	0.005	0.032	0.006
<u>Cirratulidae, unid.</u>	0	0	0	0	0	-	0	0	0.00	0	0.008	0.001
<u>Eteone nr longa</u>	0.26°	0	0	0	0.260	0.051	0.020	0.008	0	0	0.028	0.006
<u>Nephtys caeca</u>	0	T	0	0.183	0.183	0.035	0	0	0.07°	0.08°	0.150	0.029
<u>Paraonella</u>	0	T	0	0	0	T	0.01	-	-	0.01	0.02	T
<u>Platybranchia</u>	0	T	0	0	0	T	0	-	-	0	0	T
<u>Polychaeta, unid.</u>	0	0	0.010	0.163	0.173	0.025	0.43	0.032C	0.01	0.140	0.226	0.032
<u>Scolecopsis sp A</u>	0.10°	0	0.110	0.098	0.308	0.044	0	0.447	0.235	0.162	0.844	0.120
<u>Scoloplos armiger</u>	0.106)	0.095	0.125	(0.324)	0.65°	0.128	0.246	0.094)	0.75	0.659	(4.724)	0.922.
<u>amm ridea</u> ^d	0.033	0.095	0.125	0.291	0.544	0.07	0.126	0.234	0.313	0.239	0.914	0.179
<u>Eohaustorius eous</u>	0.033	T	0	0.013	0.04	0.09	0	0.010	0.02°	0.030	0.060	0.012
<u>Parapohoxus milleri</u>	0.040	0	0	0.020	0.066	0.12	0.120	2.850	0.19°	0.390	3.750	0.731
<u>misc. gammarids</u>	0.466	0.105	0.245	0.768	1.584	0.283	0.31°	3.025	1.049	1.047	6.231	1.143
Total	5.93	1.34	3.12	9.78	5.04	0.901	3.95	48.70	13.36	13.33	19.84	3.638
Biomass (g/m ²)												
Average biomass (g/m ²)												

a Based on conversion factors indicated in Thorson (1957)

b Parenthetic values are total wet whole weight for major taxa

c Only data for 9 cores

d Gammarid weights for July are estimates based on July abundance and wet weight/number ratio in April; samples were lost in the mails before weighing

was a strong increase in biomass between April and July. This reflected an increase in biomass in the dominant species, particularly Eohaustorius and Scoloplos, as well as the appearance of several additional species during this period (Table 8).

5.1.4 Size Structures

Observations on size structure were attempted for the **gammarid** Eohaustorius eous and the **polychaete** Scoelelepis to provide insight into growth rates, life cycle and eventually permit estimation of secondary production.

It was possible to examine the size structure of Eohaustorius by measuring its length (from the tip of the rostrum to the base of the **telson**) with an ocular micrometer (Appendix **IIIa**). The length-frequency histograms represent pooled samples for **all four levels** (Figure 5). Based on these data, it appears that at least two age classes occurred in the population. The younger class appeared less abundant than the older one, but this may be an artifact of the mesh size of the sieve used to screen the samples. However, reproductive potential of haustoriids is reported to be fairly low (Sameoto 1969a and b).

A comparison of the April and July modes for the young age class suggests that growth was rather slow. The modal size of the older age class appears to have decreased during the same period, perhaps due to size specific predation or post spawning mortality of larger individuals. The difference in size structure is highly significant ($P < 0.005$, Kolmogorov-Smirnov two-sample test) .

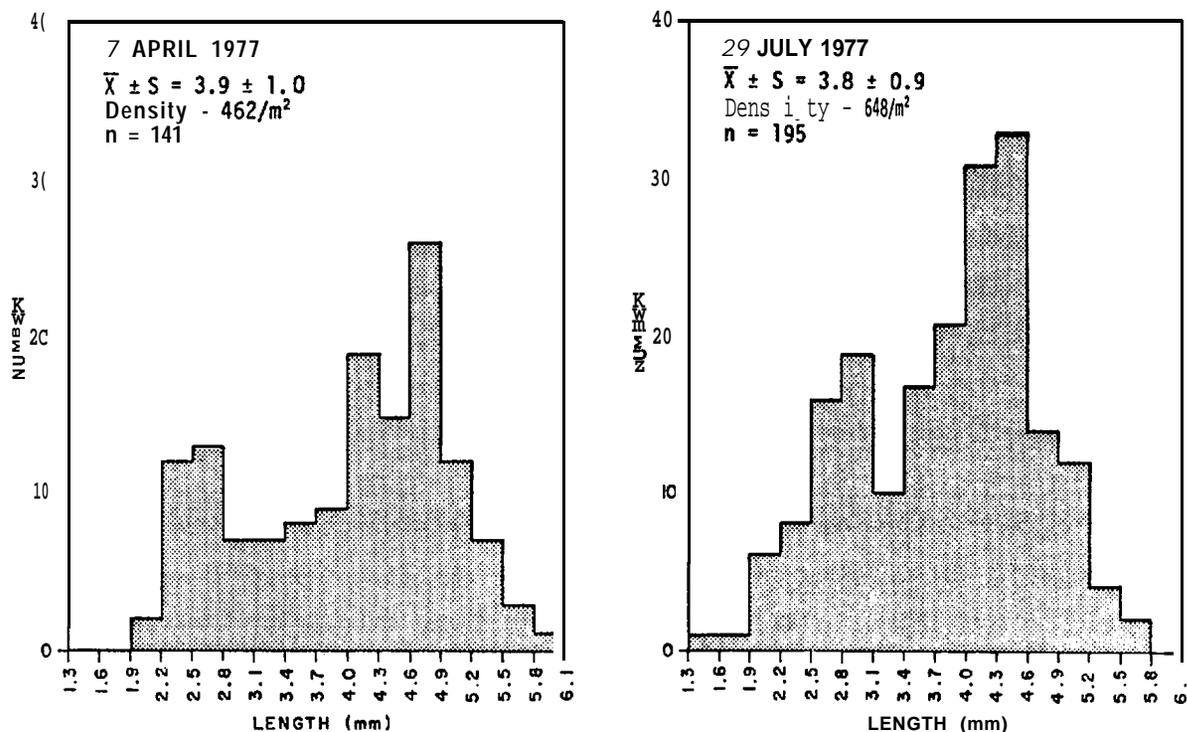


FIGURE 5 - LENGTH FREQUENCY HISTOGRAMS FOR Eohaustorius eous FROM DEEP CREEK, 1977

Size data were collected for two other gammarid amphipods but are unsatisfactory for one of several reasons. Average lengths for Paraphoxus milleri were 4.4 ± 1.7 mm in April (n = 8) and 7.7 ± 3.6 mm in July (n = 6) but the sample sizes were very small. **Gammaridae** sp A, very common in July, had an average length of 2.5 ± 0.7 mm (Appendix IIIb) , but no comparative data were available from April.

Generally, useful measurements were not obtainable for Scolecopsis because of its fragility and absence of hard parts useful in size measurements. To date, we have been unable to obtain a single whole worm. However, it is our impression based on visual examination of the samples that, on the average, worms were small in winter or spring, and large in the summer.

5.1.5 Numerical Parameters

Patterns in the numerical parameters were rather straight forward and consistent during the study. Generally, abundance, species richness and species diversity increased during the period of the survey (Table 9) . Also, the first two parameters were generally higher at the lower elevations.

The significance of the observed increase in abundance from February to July was tested separately for each level on unpooled data (Appendix I) by means of the **Kruskal-Wallis** one-way analysis of variance. The differences were found to be highly significant ($P < 0.01$) at levels 1, 2 and 3, but did not depart from random at level 4 ($P > 0.3$).

When abundance was tested in the same manner for differences among levels, highly significant differences ($P < 0.01$) were found for all sample sets. In February and April, abundances were higher at lower elevations. In contrast, the two intermediate elevations (levels 2 and 3) had the higher densities in July.

The other abundance parameters presented (total number of organisms collected per level and number per m^2) are both derived directly from the raw data. Thus, the patterns are identical, i.e., exhibiting general increases with season and, during each survey, with lower elevation.

Species richness was evaluated statistically by comparing the number of species in each core (unpooled data) among levels and surveys; again the **Kruskal-Wallis** one-way

TABLE 9. SUMMARY OF NUMERICAL PARAMETERS FOR THE SANDY INTERTIDAL ASSEMBLAGE AT DEEP CREEK

Elevation (ft)	Abundance			Species Richness		Species Diversity	Evenness		Grams Wet Weight per m ²
	Total per Level	$\bar{x} \pm s$ per Core	per m ²	Total per Level	$\bar{x} \pm s$ per Core	H	N/S	E	
4 February 1977									
0	18	1.8 ± 1.9	229.2	4	1.3 ± 0.7	1.32	4.5	0.62	
-1	21	2.1 ± 1.6	267.4	3	1.2 ± 0.4	0.70	7.0	0.54	
-2	39	3.9 ± 1.7	496.6	6	1.7 ± 0.8	1.05	6.5	0.35	
-3	84	8.4 ± 4.3	1069.5	7	2.0 ± 0.7	0.69	12.0	0.23	
Overall $\bar{x} \pm s$	162	4.1	515.7	9	1.6	0.9 ± 0.30	18.0	0.44 ± 0.18	
7 April 1977									
0	10	1.0 ± 0.9	127.3	5	(3.8 ± 0.6	1.50	2.0	0.57	5.93
-1	31	3.1 ± 3.2	394.7	5	1.2 ± 0.8	0.64	6.2	0.31	1.34
-2	35	3.5 ± 2.8	445.6	6	1.3 ± 0.9	0.96	5.8	0.32	3.12
-3	108	10.8 ± 4.8	1375.1	7	2.6 ± 1.3	C.95	15.4	0.28	9.78
Overall $\bar{x} \pm s$	184	4.6	585.7	10	1.5	1.01 ± 0.36	18.4	0.37 ± 0.13	5.04
29 July 1977									
0	39	3.9 ± 2.3	496.6	5	2.0 ± 0.9	1.15	7.8	0.44	3.95*
-1	173	17.3 ± 16.3	2202.7	12	3.9 ± 1.4	1.72	14.4	0.27	48.70
-2	101	10.1 ± 4.9	1286.0	11	3.4 ± 1.3	1.56	9.2	0.27	13.36
-3	84	8.4 ± 6.2	1069.5	9	2.7 ± 1.3	1.61	9.3	0.34	13.33
Overall $\bar{x} \pm s$	391	9.9	1263.7	16	3.0	1.51 ± 0.25	24.4	0.33 ± 0.08	19.84

* Biomass for gammarids in July based on average weight/specimen in April; animals lost in mails.

analysis of variance was used. The differences observed among surveys at a given level were significant at level 1, highly significant at **levels 2 and 3**, but not significant ($p > 0.5$) at **level 4**. At levels 1 and 3, fewest species per core were encountered in April, but at all levels, greatest species richness occurred in July. The total number of species encountered in each survey also increased during the study (Table 9). In February and **April**, there was a fairly well-defined increase in species richness at the lower sampling levels, but this pattern was not apparent in July.

Species diversity (H) generally increased from February to July, but was quite variable among the levels within each period. However, neither the patterns of variation with season nor with elevation were significant.

Evenness parameters generally indicated that species were less equitably distributed at lower elevations and in the later surveys. This is mainly a reflection of large **increases in** the density of populations of a rather limited number of species at lower elevations and through time. However, in all surveys, over 50 percent of the species were represented by three **or** fewer specimens. None of the patterns was statistically significant.

Species-area curves were constructed for each level and survey to provide insight into rates of species acquisition in the samples and the suitability of the sampling program. In most cases, the curves for specific levels show signs of becoming asymptotic (Figure 6). **Only** at levels 2, 3 and 4 in July does it appear that a substantial number of additional species might have been obtained by further sampling. Such patterns emphasize the low species richness and high N/S ratios reported above.

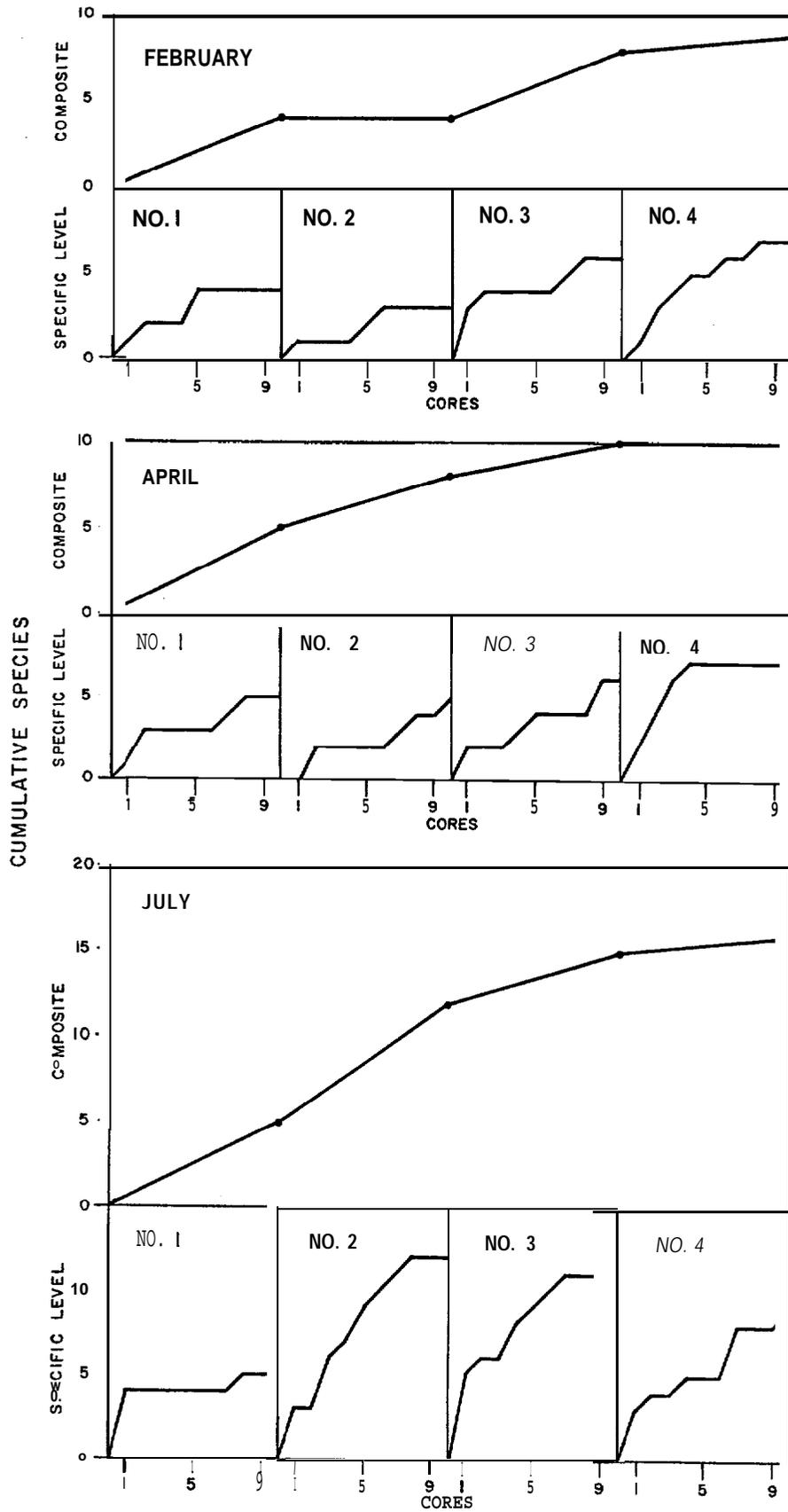


FIGURE 6 - SPECIES/AREA CURVES FOR DEEP CREEK

Composite species-area curves were constructed for each survey by **tabulating, by level,** the cumulative number of species identified. In all cases, the rate of "accrual" was fairly slow and uniform. This is probably a reflection of the intensity of the physical gradients. It is not **surprising,** however, that July, the mildest period sampled, initially produced the most rapid rate of "accrual" (the steepest slope) . During that period, many less tolerant species were able to expand their local distribution to shallower levels.

5.2 BIOLOGICAL ASSEMBLAGE OF THE SAND BEACH AT HOMER SPIT

The **infaunal** assemblage at the Homer Spit station was sampled three times during the period covered by this report, namely on 17 February, 7 March and 28 July 1977. A total of 25 taxa, including 11 **polychaete,** 8 crustacean, and two **molluscan** (Table 1) , was identified from the core samples.

Quantitatively, the infauna was dominated heavily by **polychaetes,** especially Paraonella platybranchia and Scolelepis sp. A (Table 10). Relative abundance of all groups was fairly uniform. Gammarid amphipods were **substantially less** important, with Eohaustorius and Paraphoxus the most abundant. The redneck clam (Spisula) and a fish (sand lance, Ammodytes) were encountered in low numbers in each survey. The raw data for these samples, by core, level and **survey,** are presented in Appendix IV and species summaries in Appendix V.

5.2.1 Zonation

To examine zonation, the species at each level

TABLE 10. OVERALL DENSITY (NO./M²) OF COMMON SPECIES AT HOMER SPIT SITE

Taxa	2/77 Density	%	3/77 Density	%	7/77 Density	%
Polychaeta		(75.8) ^a		(84.8)		(78.1)
<u>Eteone</u> nr. <u>longa</u> ^{b,c}	6.4	1.0	0	0	3.2	0.3
<u>Nephtys</u> ? <u>ciliata</u>	6.4	1.0	9.5	1.0	3.2	0.3
<u>Paraonella</u> <u>platybranchia</u>	146.4	24.2	38.2	7.3	213.3	20.4
<u>Scolelepis</u> Sp. A ^{b,c}	273.7	45.2	385.2	73.3	547.5	52.3
Gammaridea		(16.8)		(12.7)		(5.8)
<u>Eohaustorius</u> <u>eous</u>	19.1	3.1	12.7	2.4	28.7	2.7
<u>Paraphoxus</u> <u>milleri</u> ^{b,c}	44.6	7.3	50.9	9.7	19.1	1.8
Pelecypoda						
<u>Spisula</u> <u>polynyma</u> ^b	12.7	2.1	3.2	0.6	6.4	0.6
Pisces						
<u>Ammodytes</u> <u>hexapterus</u> ^b	12.7	2.1	6.4	1.2	3.2	0.3

^a Parenthetic values are percent of the overall total individuals within the major taxon indicated

^b These species were also common in sandy infaunal samples collected at 200' depths in the middle of Lower Cook Inlet

^c Also found at Deep Creek

were assigned, by survey, to "importance" categories according to their density and frequency of occurrence (see METHODS section) . Species composition was then compared among the sampling levels. According to these criteria, the upper two levels were dominated by Scolelepis, level 3 by Scolelepis, Paraonella and Paraphoxus and the lower level by Scolelepis. (Table 11). Paraonella and Scolelepis were important at all levels, and the latter dominated throughout.

The relationship between elevation and density was examined, with the Kruskal-Wallis analysis of variance. Scolelepis was significantly more dense at lower elevations ($P < 0.001$). The density pattern of Paraonella, high toward the middle of the beach and lower at the upper and lower levels, was also highly significant ($P < 0.01$).

5.2.2 Seasonal Patterns

The seasonal patterns apparent in Table 10 are not statistically significant even though the differences are large in some cases. The density of the polychaete Scolelepis, for example, increased two-fold from February to July. The cumaceans Lamprops spp. became abundant in July.

Samples were collected in March immediately following a large storm to attempt to examine the effects of that disturbance. Generally, it appeared that the storm had little effect. However, a comparison of density of species between the February and March surveys provides some insight on vertical distribution within the sediment. Density reductions were noted for several species (e.g., Eteone, Eohaustorius, Spisula and Ammodytes) but only Paraonella was reduced significantly ($P < 0.05$; Table 10) and only at the 100 m level. That reduction following storm surf suggests

TABLE 11. IMPORTANT SPECIES AT EACH LEVEL AT HOMER SPIT

Species	30	Sampling Level (m)		
		75	100	135
Polychaetes				
<u>Nephtys ?ciliata</u>		Frequent		
<u>Paraonella platybranchia</u>	Frequent	Frequent	Dominant	Frequent
<u>Scoelelepis</u> Sp. A	Dominant	Dominant	Dominant	Dominant
Crustaceans				
<u>Eohaustorius eous</u>		Sub-dominant	Sub-dominant	Frequent
<u>Lamprops carinata</u>				Seasonal
<u>L. quadriplicata</u>	Seasonal			
<u>Paraphoxus milleri</u>	Frequent		dominant	Sub-dominant
Pelecypods				
<u>Spisula polynyma (juv.)</u>				Sub-dominant
Fishes				
<u>Ammodytes hexapterus</u>			Frequent	

TABLE 12. DISTRIBUTION OF WHOLE WET AND ESTIMATED DRY WEIGHTS IN SAMPLE SETS AT HOMER SPIT IN 1977 (WEIGHTS IN GRAMS)

Sampling Level:	March				Survey Total		July				Survey Total	
	30m	75m	100m	135m	Wet Weight	Dry Weight ^a	30m	75m	100m	135m	Wet Weight	Dry Weight
Polychaeta	(0.080) ^b	(0.810)	(2.571)	(2.350)	(5.811)	(0.831)	(0.247)	(1.529)	(1.657)	(6.224)	(9.657)	(1.448)
<u>Abarenicola pacifica</u>	0	0	0	0	0		0	0.015	0	0	0.015	0.003
<u>Capitella capitata</u>	0	0	0	0	0		0	0	0.010	0.060	0.070	0.013
<u>Magelona pitelkai</u>	0	0	0	0.030	0.030	0.006	0	0	0	0	0	
<u>Nephtys sp.</u>	0	0.020	0.005	0	0.025	0.005	0.184	1.140	-	0	1.324	0.255
<u>Paraoneella platybranchia</u>	0		0.005	0	0.005	0.001	0.012	0.010	0.023	0.015	0.060	0.011
<u>Sabellidae, unid.</u>	0	0	0.005	0	0.005	0.001	0	0	0	0	0	
<u>Scolelepis sp A</u>	0.080	0.790	2.556	2.240	5.666	0.807	0.048	0.364	1.624	6.149	8.185	1.166
<u>Spio sp</u>	0	0	0	0.080	0.080	0.011	0	0	0	0	0	-
<u>Spiophanes bombyx</u>	0	0	0	0	0		0.003	0	0	0	0.003	T
Gammaridea	(0.010)	(0.085)	(0.039)	(0.075)	(0.209)	(0.041)	(0.029)	(0.035)	(0.098)	(0.029)	(0.191)	(0.038)
<u>Eohaustorius eous</u>	0	0.005	0.009	0.005	0.019	0.004	0.009	0.005	0.018	0.009	0.041	0.008
<u>Parapoxus milleri</u>	0.010	0.050	0.030	0.070	0.160	0.031	0.020	0	0.020	0.020	0.060	0.012
misc. gammarids	0	0.030	0	0	0.030	0.006	T	0.030	0.060	0	0.090	0.018
Total	0.090	0.895	2.610	2.425	6.020	0.872	0.276	1.564	1.755	6.253	9.848	1.486
Biomass (g/m²)	1.15	11.40	33.23	30.88			3.51	19.91	22.35	79.62		
Average biomass (g/m²)					19.17	2.78					31.35	4.73

^a Based on conversion factors indicated in Thorson 1957

^b Parenthetic values are total wet whole weight for large taxa

that these species live near the surface of the sediment. In contrast, the density of Scolelepis, which usually lives at least 15 cm below the surface, increased from February to March.

5.2.3 Biomass

In terms of biomass, the fauna at Homer Spit was strongly dominated by polychaetes in both March and July (Table 12). Scolelepis was by far the most important species at every level and in both surveys. Paraphoxus was the most important gammarid.

Biomass was relatively low but appeared only slightly affected by large, uncommon species. Two trends were fairly clear. Spatially, biomass increased markedly at lower elevation. Temporally, biomass increased sharply from April to July. Both patterns are mainly reflections of increases in Scolelepis. Gammarids showed little change by location or between periods.

5.2.4 Size Structures

Size data were collected for the gammarid amphipods Paraphoxus milleri and Eohaustorius eous, but the sample sizes were too small to provide satisfactory comparisons. The average size of Paraphoxus was 6.2 ± 1.1 mm in March (n = 7) and 6.1 ± 1.5 mm in July (n = 5). Data are not available for Eohaustorius in March, but average length was 3.8 ± 0.5 mm in July (n = 5).

5.2.5 Numerical Parameters

Patterns in the numerical parameters were fairly straight-forward and consistent during the survey. Basically, abundance, species richness and species diversity increased during the survey and, except for species diversity, at lower elevations (Table 13) . Among the evenness **parameters**, N/S also increased during the study and at lower elevations, whereas E declined during the study and **at** lower elevations.

The significance of the observed increases from February to July was tested separately for each level on **unpooled** data (Appendix IV) using the **Kruskal-Wallis** analysis of variance. The seasonal increases in abundance were significant ($P < 0.05$) at the 30 m, 75 m and 135 m levels, but did not depart from random at the 100 m level. Similar analysis of abundance patterns among levels during a survey indicated that the increase in density at lower elevations observed in each survey were highly significant ($P < 0.01$) .

Species richness was examined similarly by comparing the number of species per core among levels and surveys with the **Kruskal-Wallis** test. The seasonal changes observed at specific levels were significant at the 30 m ($p < 0.01$), 75 m and 135 m levels (for both, $P < 0.05$). Generally, there was a decline from February to March, and an increase by **July** at each level. Only in March were the observed differences among levels significantly different from random ($P < 0.01$). In both February and March, the average number of species per core was highest at the 100 m level. These patterns were fairly well reflected by the total number of

TABLE 13. SUMMARY OF NUMERICAL PARAMETERS FOR THE SANDY INTERTIDAL ASSEMBLAGE AT HOMER SPIT

Sampling Level (m)	Abundance			Species Richness		Species Diversity	Evenness		Grams Wet Weight per m ²
	Total per Level	$\bar{x} \pm s$ per Core	per m ²	Total per Level	$\bar{x} \pm s$ per Core	H	N/S	E	
17 February 1977									
~30	12	2.4 ± 1.7	305.6	4	2.0 ± 1.2	1.25	3.0	0.60	
~75	8	1.6 ± 1.5	203.7	5	1.4 ± 1.5	1.52	1.6	0.57	
100	33	6.6 ± 2.1	840.4	7	3.8 ± 1.3	1.89	4.7	0.53	
135	42	8.4 ± 3.2	1069.6	7	3.0 ± 1.6	1.77	6.0	0.49	
Overall $\bar{x} \pm s$	95	4.8	604.8	14	2.6	1.61 ± 0.28	6.79	0.55 ± 0.05	
7 March 1977									
30	9	0.9 ± 1.1	114.6	3	0.6 ± 0.7	0.71	3.0	0.55	
75	25	2.5 ± 1.6	318.3	6	1.7 ± 0.8	1.60	4.2	0.51	
100	48	4.8 ± 3.0	611.2	8	2.3 ± 1.2	1.58	6.0	0.37	
135	83	8.3 ± 6.3	1056.9	6	2.0 ± 0.8	0.75	13.8	0.28	
Overall $\bar{x} \pm s$	165	4.1	525.3	12	1.7	1.16 ± 0.50	13.8	0.43 ± 0.13	
28 July 1977									
30	64	6.4 ± 5.1	814.9	12	3.3 ± 2.2	2.25	5.8	0.43	
75	47	4.7 ± 2.2	585.7	9	2.9 ± 1.2	2.16	5.1	0.50	
100	75	7.5 ± 2.9	955.0	9	3.0 ± 0.7	1.69	8.3	0.36	
135	144	14.4 ± 5.2	1833.6	10	3.3 ± 1.4	1.26	16.0	0.27	
Overall $\bar{x} \pm s$	330	8.3	1047.3	16	3.1	1.84 ± 0.46	20.6	0.39 ± 0.10	

species per level and the overall number of species per survey (Table 13). However, the pattern for species richness was rather confused in July.

Species diversity was, on the average, highest at each level, and overall, in July. However, the relationships among levels in a specific survey were confused.

Evenness patterns generally indicated that the species were less equitably distributed at the lower levels and in the later surveys. The decrease in evenness with lower elevation is a reflection of the relatively moderate increase in species richness in comparison with the increase in density. The average decrease in evenness during the study is a reflection of substantial density increases among a fairly stable suite of species.

Species-area curves were constructed for each level and survey to provide insight into rates of species acquisition in the samples and the suitability of the sampling program. Generally, the curves for specific levels showed signs of becoming asymptotic (Figure 7). However, it appears that a substantial number of species could have been added by additional sampling at the 30 m and 135 m levels in July. This pattern accentuates the finding of low species diversity and high N/S ratios.

Composite species-area curves were constructed for each survey by tabulating by level the cumulative number of species identified. In February and March, the rate of "accrual" was fairly slow and uniform at each level. This seems to indicate a strong gradient for physical factors.

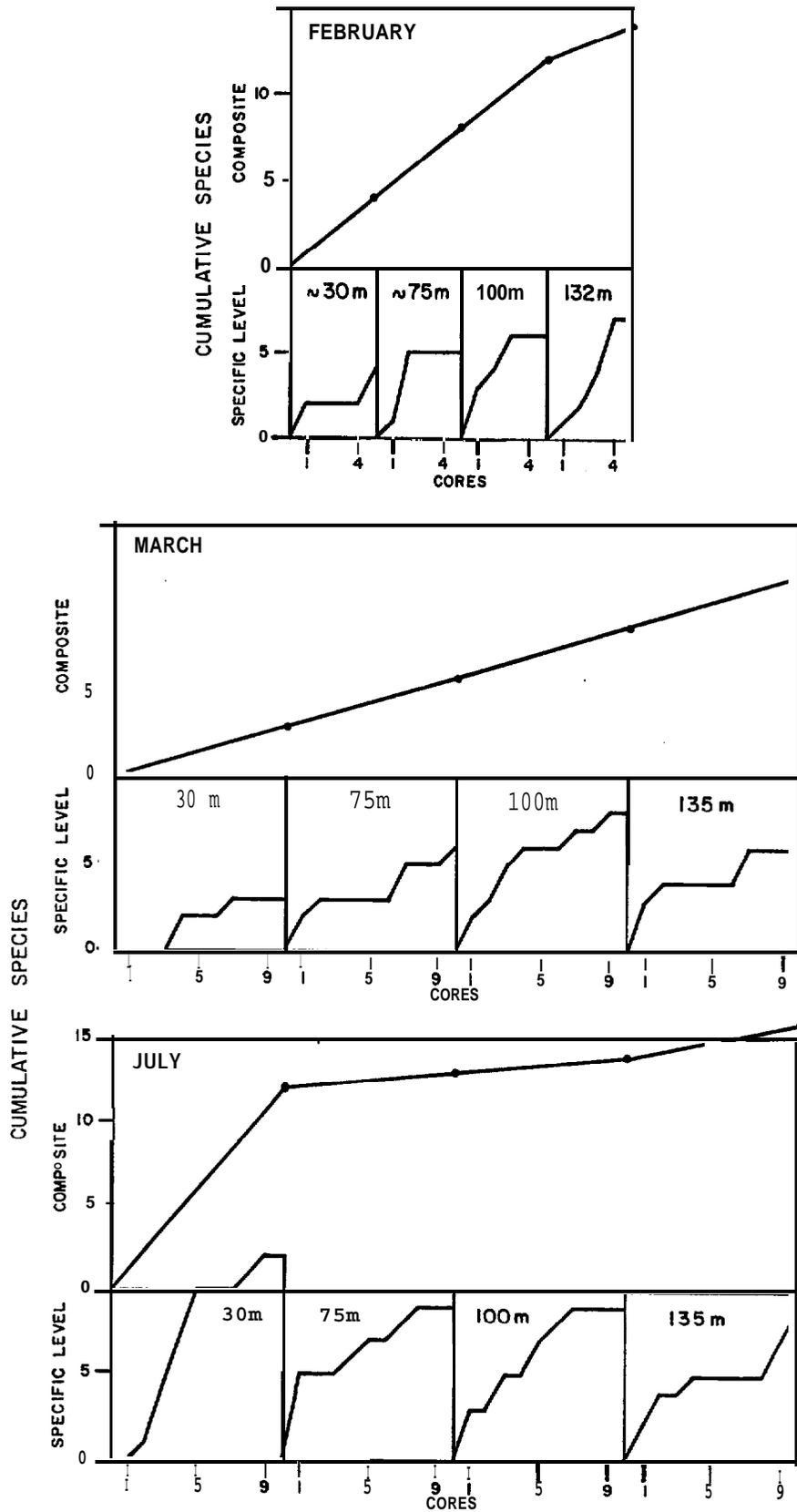


FIGURE 7 - SPECIES/AREA CURVES FOR HOMER SPIT

This interpretation 'is amplified by the composite curve for July, when conditions were comparatively very mild. In this case, the rate of "accrual" is initially rapid, i.e. , most of the species observed were identified at the upper level, and the subsequent rate is quite slow. Although this suggests that the mild conditions have allowed a number of species previously restricted to lower levels to expand into higher elevations, examination of the species lists from the intertidal levels does not support this hypothesis.

5.3 BIOLOGICAL ASSEMBLAGE OF THE MUD FLATS AT GLACIER SPIT, CHINITNA BAY

The infaunal assemblage at Glacier Spit, Chinitna Bay, (Figure 1) was sampled twice during the period covered by this report, namely on 6 April, and 30 July, 1977. A total of 45 taxa, including 22 annelids, nine arthropods, and nine molluscs, was identified in the core samples (Table 2). Twenty of these taxa, including 67 percent of the molluscs and 50 percent of the annelids, were observed in both sample sets. Only one arthropod taxon occurred in both surveys; in fact, that species, a caprellid amphipod, Tritella pilimana, was the only crustacean of any importance.

In terms of abundance and biomass, the fauna was dominated heavily by pelecypods, especially Macoma balthica and Mya spp., (Table 14) . Relative abundance was uniform between surveys. Furthermore, these clam species comprised at least 90 percent of the whole wet weight in the samples, while the remaining taxa contributed little. Several other species, especially the polychaete worms Nephtys, Potamilla, and Spio, and the clams Clinocardium and Pseudopythina, contributed at least marginally to density. Raw abundance data by core are presented in Appendix VI, and biomass data by

TABLE 14. OVERALL DENSITY (NO./M²) AND BIOMASS^a OF COMMON TAXA AT THE GLACIER SPIT, CHINITNA BAY SITE

	4/6/77				7/30/77			
	Density (no./m ²)	%	Biomass (g/m ²)	%	Density	%	Biomass	%
Echiurida								
<u>Echiurus echiurus</u>	38.2	0.6	22.82	1.0	41.4	0.8	31.80	0.8
Polychaeta		(9.5) ^b		(1.6)		(31.0)		(2.0)
<u>Ampharete acutifrons</u>	12.8	0.2	0.05	T	28.7	0.6		
<u>Capitella capitata</u>	15.9	0.2	0.07	T	111.4	2.2		
<u>Eteone nr longs</u>	38.2	0.6	0.55	T	121.0	2.4	0.73	T
<u>Harmothoe imbricata</u>	9.5	0.1	0.77	T	63.7	1.3	8.13	0.2
<u>Malacoceros sp</u>	15.9	0.2	0.04	T	38.2	0.8	0.05	T
<u>Nephtys sp</u> (adults & (juvenile)	331.0	5.0	27.92	1.2	324.7	6.5	59*94	1.5
<u>Phyllodoce groenlandica</u>	15.9	0.2	1.58	0.1	28.7	0.6	4.07	0.1
<u>Polydora caulleryi</u>	15.9	0.2	0.03	T	54.1	1.1	0.05	T
<u>Potamilla sp</u>	117.8	1.8	2.13	0.1	245.1	4.9	4.86	0.1
<u>Scoloplos armiger</u>	3.2	T	0.01	T	38.2	0.8	0.04	T
<u>Spio filicornis</u>	0	0	0	0	448.8	9.0	0.98	T
Crustacea		(0.1)		(T)		(4.9)		(T)
<u>Tritella ?pilimana</u>	3.2	T	T	T	187.8	3.8	T	T
Pelecypoda		(88.8)		(97.6)		(62.8)		(97.3)
<u>Clinocardium nuttallii</u> (juv. & adults)	213.3	3.2	1.53	0.1	105.0	2.1	201.8	5.0
<u>Macoma balthica</u>	4672.8	71.0	502.93	21.7	2654.7	53.4	461.55	11.4
<u>Mya sp</u>	804.8	12.2	1755.53	75.7	213.3"	4.3	3257.53	80.7
<u>Pseudopythina sp</u>	144.7	2.2	1.94	0.1	140.1	2.8	6.6	0.2

^a Based on whole preserved weights

^b Parenthetic numbers are total percentages in major taxa

core in Appendix VII. These types of data are summarized, by species, in Appendices VIII and IX. Size and weight data for several species are in Appendix X.

5.3.1 Seasonal Patterns

Several seasonal patterns are apparent in the Chinitna Bay samples. The average number of specimens per core, and thus the other abundance parameters, decreased from April to July (Table 15; $P \ll 0.001$, with Student's T-test). However, within this general pattern, two strong trends were discerned. Density of polychaetes and the caprellid increased dramatically between surveys ($P \ll 0.005$, Wilcoxin matched-pairs signed ranks T-test). In contrast, most of the clams became substantially less abundant ($P > 0.05$) during the same period.

5.3.2 Zonation

To examine zonation, the species at each level were assigned, by survey, to "importance" categories according to their density and frequency of occurrence (see METHODS section). Species composition was then compared among the sampling levels. According to these criteria, all levels were numerically dominated by a small pink clam Macoma balthica, and a polychaete Nephtys was subdominant at each (Table 16). Additionally, the polychaete Eteone occurred frequently at all levels. Other species that were important at all levels sampled were a tubicolous polychaete Potamilla and the clams Clinocardium, Mya spp. (unidentified juvenile specimens) and a commensal clam Pseudopythina. The eastern soft shell clam, Mya arenaria, was only important at the two upper levels and M. priapus at the lower two levels. Several

TABLE 15. SUMMARY OF NUMERICAL PARAMETERS FOR THE MUDDY INTERTIDAL ASSEMBLAGE AT GLACIER SPIT, CHINITNA BAY

Elevation (ft)	Total per Level	Abundance		Species Richness		Species Diversity	Evenness		Grams We Weight ₂ per m ²
		$\bar{x} \pm s$ per Core	per m ²	Total per Level	$\bar{x} \pm s$ per Core	H	N\S	E	
6 April 1977									
+3.6	428	42.8 ± 16.7	5450	16	4.7 ± 2.6	0.85	26.8	0.16	4163.66
+2.5	435	43.5 ± 8.4	5539	16	6.6 ± 1.6	1.12	27.2	0.22	2975.03
+0.9	642	64.2 ± 18.7	8175	15	7.0 ± 1.3	1.41	42.8	0.22	1144.08
-1.2	563	56.3 ± 17.3	7156	20	6.7 ± 2.0	1.40	28.2	0.22	996.46
Overall $\bar{x} \pm s$	2068	51.7	6580	25	6.3	1.20 ± 0.27	82.7	0.21 ± 0.03	2319.81
30 July 1977									
+3.6	250	25.0 ± 6.2	3183	20	6.4 ± 2.4	1.81	12.5	0.17	3743.89
+2.5	395	39.5 ± 13.7	5030	24	9.8 ± 2.5	2.82	16.5	0.27	3974.22
+0.9	441	44.1 ± 14.9	5615	25	10.1 ± 3.1	2.88	17.6	0.28	4858.09
-1.2	475	47.5 ± 13.9	6048	25	10.2 ± 3.3	2.54	19.0	0.22	3576.88
Overall $\bar{x} \pm s$	1561	39.0	4969	36	9.1	2.51 ± 0.49	43.4	0.24 ± 0.05	4038.27

TABLE 16. IMPORTANT SPECIES AT EACH LEVEL AT GLACIER SPIT,
CHINITNA BAY

Species	Elevation (ft)			
	+3.6	+2.5	+0.9	-1.2
<u>Echiurus echiurus</u>		Frequent	Frequent	
Polychaetes				
<u>Capitella capitata</u>		Frequent	Frequent	Frequent
<u>Eteone</u> nr <u>longa</u>	Frequent	Frequent	Frequent	Frequent
<u>Harmothoe imbricata</u>			Frequent	
<u>Nephtys</u> sp	Sub-dominant	Sub-dominant	Sub-dominant	Sub-dominant
<u>Phyllodoce groenlandica</u>				Frequent
<u>Polydora caulleryi</u>		Frequent		
<u>Potamilla</u> sp	Frequent	Frequent	Sub-dominant	Frequent
<u>Spiro ?filicornis</u>		Seasonal	Seasonal	Frequent
Caprellidea				
<u>Tritella ?</u>		Seasonal	Seasonal	Frequent
Pelecypods				
<u>Clinocardium nuttallii</u>	Frequent	Frequent	Sub-dominant	Sub-dominant
<u>Macoma balthica</u>	Dominant	Dominant	Dominant	Dominant
<u>Mya arenaria</u>	Frequent	Frequent		
<u>M. priapus</u>			Frequent	Frequent
<u>Mya</u> spp (juv)	Frequent	Frequent	Sub-dominant	Dominant
<u>Pseudopythins</u> sp	Frequent	Frequent	Sub-dominant	Frequent

other species became more important at lower levels, including the worm Spio, the caprellid Tritella, and the clams Clinocardium and Mya spp. (juveniles) .

Consistent patterns of vertical distribution in the sediment were evident from field observations for several species (Figure 8) . The caprellid lives on filamentous algae at the water-mud interface, (Benedict, personal communication) , whereas most of the other species live in the sediments. Most of the polychaetes live near the sediment surface. However, Potamilla constructs tubes extending well into the sediment, and Nephtys adults live in burrows with at least two openings that extend to a depth of at least 15 cm into the sediment. Echiurus (Figures 8 and 9) constructs U-shaped burrows that may extend down into the sediment at least 30 cm. Pseudopythina appears to live in these burrows as a commensal, sometimes occurring attached to the spoonworm by byssus threads. The scaleworm Harmothoe is a commensal and appears in burrows with Nephtys, Echiurus and Mya. Juveniles of Macoma, Mya and Clinocardium live in the surface sediments. Adult Clinocardium live with the anterior margin of the shell right at the water-mud interface. Macoma and Mya burrow deeper as they grow larger, a trait which provides considerable protection from predators, physical stress and disruption. Adult Macoma balthica (Figures 8 and 9) generally live within 5 cm of the sediment surface. Adults of Mya spp. burrow down to at least 30 cm into the sediment and form semi-permanent burrows communicating vertically with the surface (Figures 8 and 9) .

These patterns result in a substantial vertical distribution of the biomass in the upper 30 cm of the sediment. Furthermore , the burrowing habit of Mya spp. and

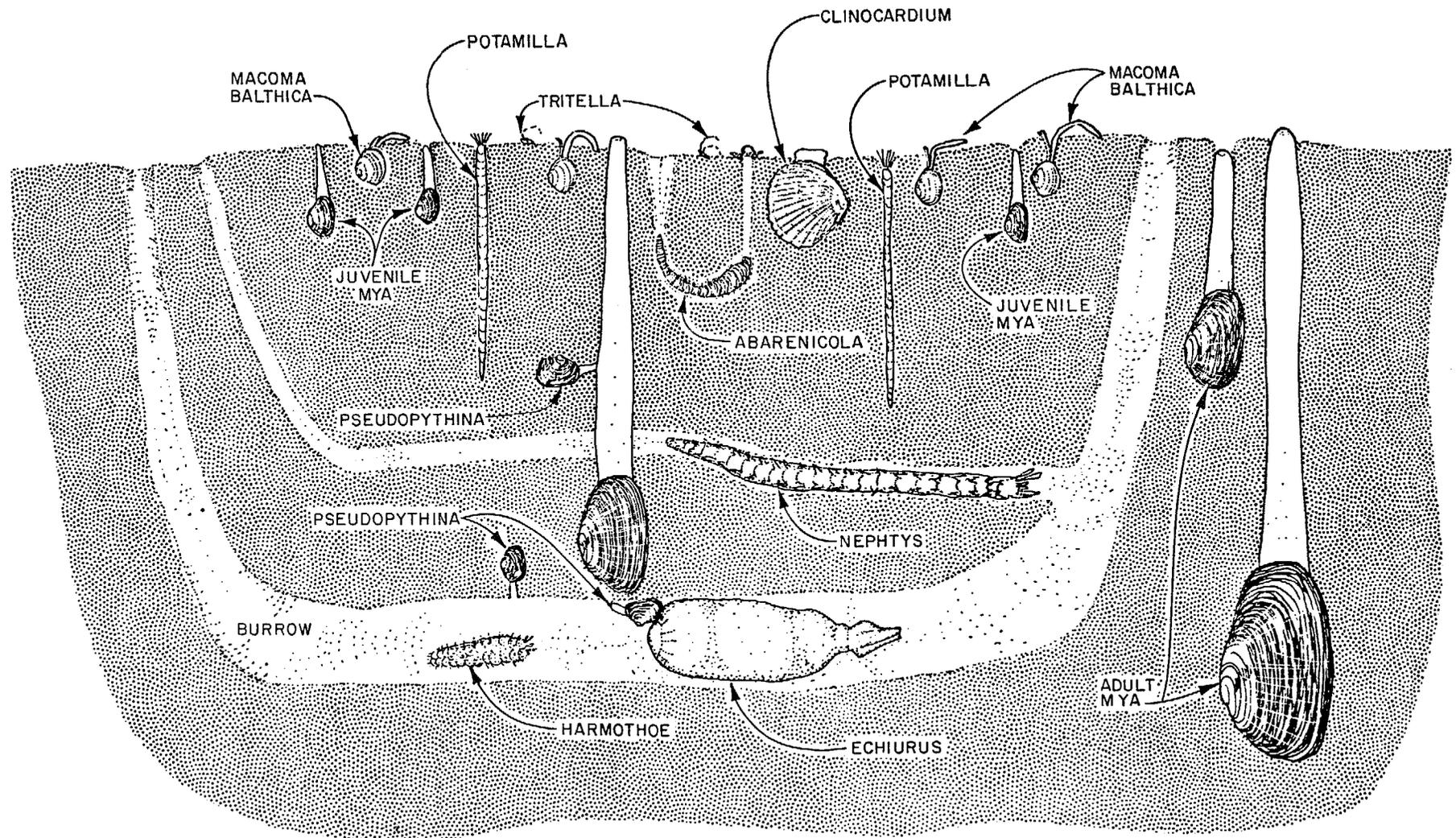


FIGURE 8 - DISTRIBUTION OF MAJOR ORGANISMS IN THE FAUNAL ASSEMBLAGE ON THE MUD FLAT AT GLACIER SPIT, CHINITNA BAY

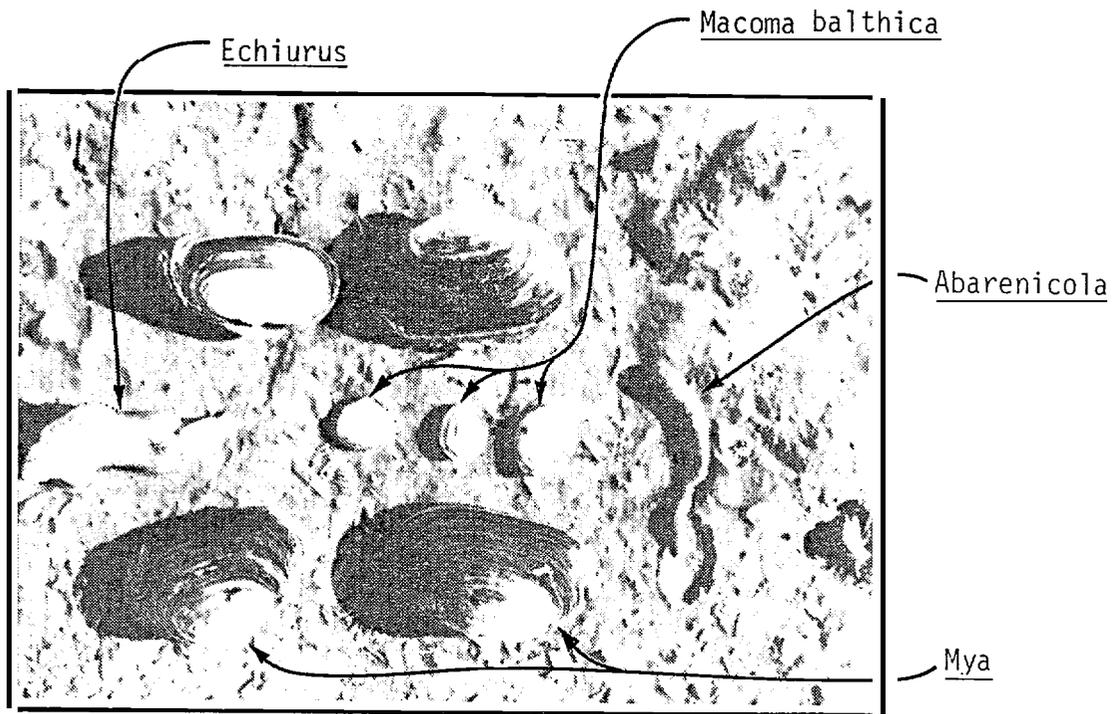


FIGURE 9 - SEVERAL DOMINANT SPECIES IN THE MUD FLAT ASSEMBLAGE AT GLACIER SPIT, CHINITNA BAY

Echiurus results in a fair degree of porosity in the upper 30 cm of the mud flats (Figures 8, 9 and 10). In Figure 10, the large holes were formed by adult Mya spp., and the smaller holes by Macoma balthica, polychaetes and Echiurus.

5.3.3 Biomass

During the survey, biomass (compared in Tables 15 and 17) , generally increased significantly on the average and for most species examined ($P = 0.005$; Wilcoxin T-test) . Among the major species, only Macoma exhibited a decline in biomass. Clam species contributed over 90 percent to both the wet and dry weight estimates for the mud flat examined.

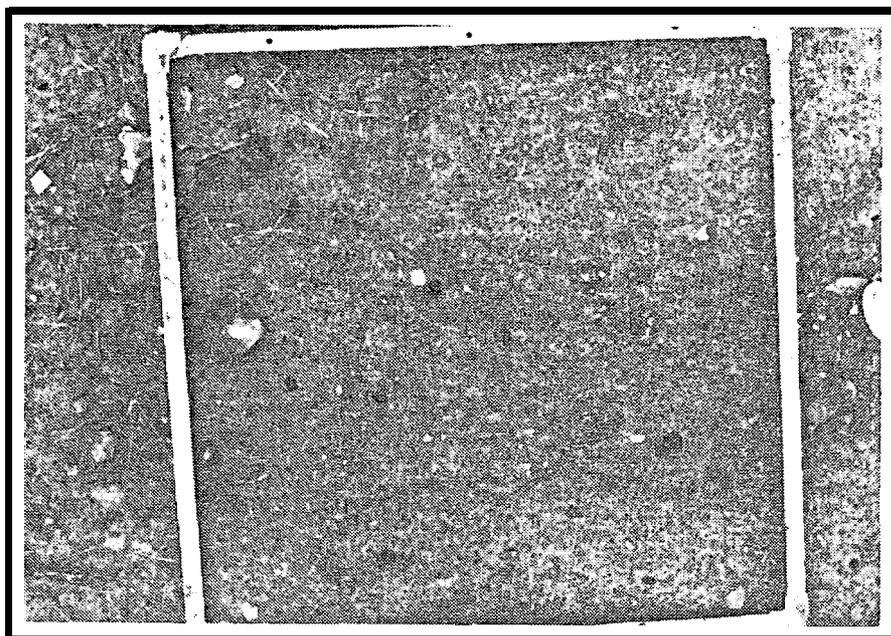
TABLE 17. SUMMARY OF BIOMASS DATA FOR THE MUFLAT ASSEMBLAGE,
GLACIER SPIT, CHINITNA BAY IN 1977

	Average Whole Wet Weight (g/m ²)		Conversion Factor	Estimated Dry Tissue Weight (g/m ²)	
	April	July		April	July
<u>Echiurus</u>	22.82	31.80	14% ^a	3.19	4.45
<u>Polychaetes</u>	35.06	78.99	14% ^b	4.91	11.06
Clams					
<u>Clinocardium</u>	1.53	201.8	5% ^a	0.08	10.09
<u>Macoma balthica</u>	502.93	461.55	5.75% ^b	28.92	26.54
<u>Mya spp</u>	1755.53	3257.53	6.6% ^b	115.86	215.00
<u>Pseudopythina</u>	1.94	6.6	5.4% ^c	0.10	0.36
Total	2319.81	4038.27		153.06	267.5

^a Estimates based on examination of Thorson (1957)

^b Based on conversions published in Thorson

^c Average for pelecypods in Thorson



**FIGURE 10 - SURFACE OF THE MUD FLAT AT BRUIN BAY
INKAMISHAK BAY, LOWER COOK INLET,
SHOWING THE POROSITY
AS A CONSEQUENCE OF BIOLOGICAL ACTIVITY**

Data in Appendix VII indicate that adult Mya arenaria and M. priapus are particularly important. Echiurus and polychaetes contribute less than two percent each to standing stocks. Among the polychaetes, Nephtys contributes most. Clinocardium displayed the highest rate of increase in biomass, and the magnitude of change was probably due mainly to growth.

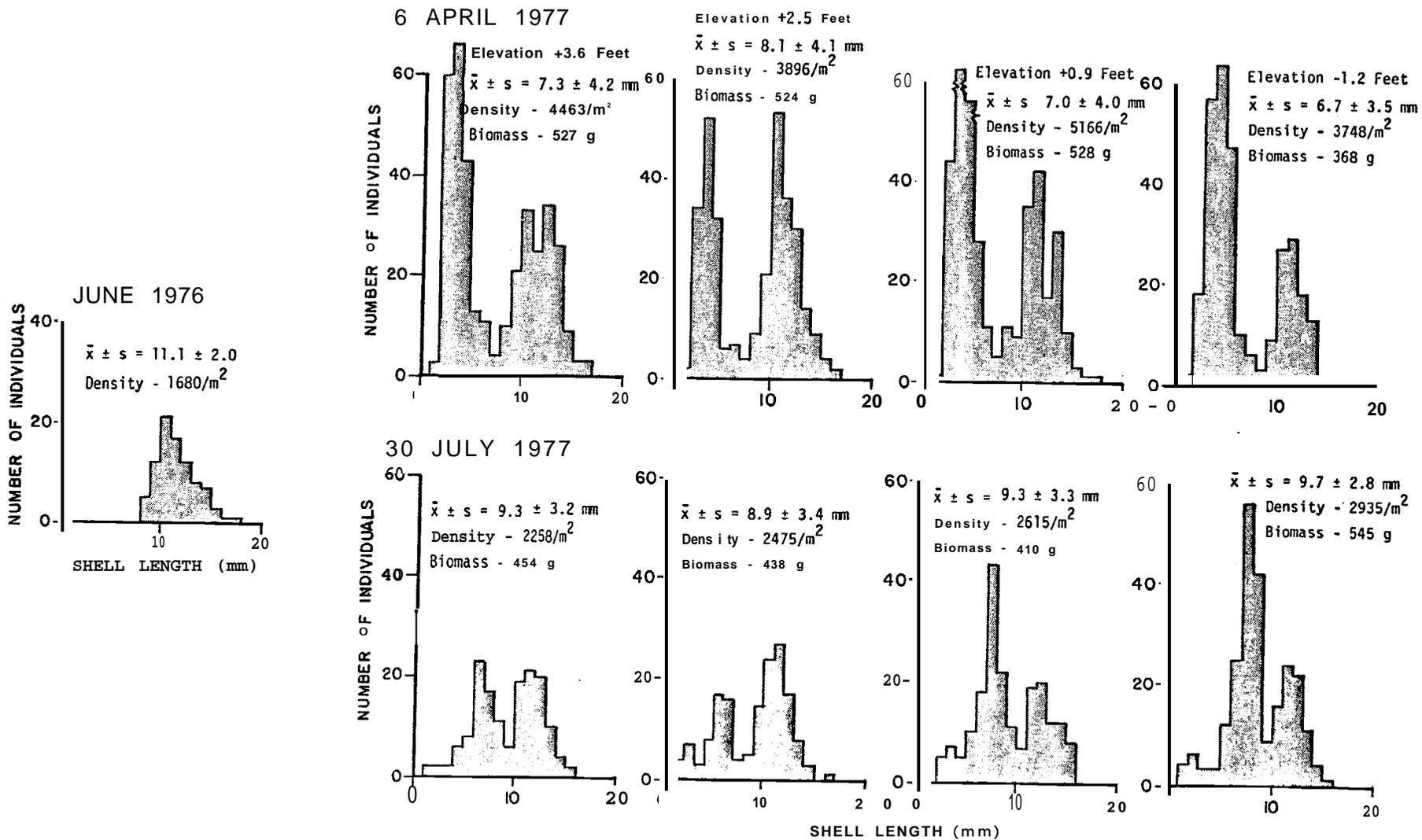
5.3.4 Biology Of Macoma balthica

Observations on size structure were made for all of the clams collected to provide insight into growth rates

and life cycles as well as to assist in estimation of secondary production (Appendix X). The most useful data were for Macoma balthica and Mya spp. In all cases, the measurement used was shell length.

Length-frequency histograms for Macoma balthica from a 1976 collection and for both 1977 sampling periods covered by this report are included in Figure 11. These histograms also indicate the mean size of the distribution, its standard deviation, and estimates for density and whole wet weight per m², where available. This comparison reveals several important features about the population structure of Macoma. Generally, all levels exhibited similar size structures during the same sampling period. In April 1977, members of the 0-year class were considerably more numerous than those in the older mode. By July, the difference was substantially reduced, particularly at the +3.6 foot and +2.5 foot levels, where the two modes were nearly equal in abundance. The 0-year class remained more numerous at the two lower levels in July. Except at the lowest level, the older mode was also reduced substantially between April and July. The decline of both modes resulted **in** the large reduction **in** overall density observed at all levels by July. These density reductions ranged from 22 percent at the -1.2 foot level to 49 percent at the +3.6 and +0.9 foot levels and averaged 39 percent. All reductions were significant (P <0.01 in all cases; **Kruskal-Wallis** analysis of variance) .

Growth was apparent in both modes (Figure 11). The 0-year class increased from between 3 and 4 mm in **April** to between 6 and 7 mm in July. The larger mode probably includes several year classes, so changes in the modal **mean** do not **accurately** reflect age-specific growth rates.

FIGURE 11 - PATTERNS IN SIZE, ABUNDANCE AND BIOMASS FOR MACOMA BALTHICA

CHINITNA BAY

Above MLLW, biomass (wet whole weight) decreased between April and July. However, a substantial increase was observed at the -1.2 foot **level**. This was **apparently** a consequence of growth, combined with a relatively limited reduction **in** density.

The comparison of these histograms to the one for 1976 is quite revealing. The conspicuous absence of a 0-year class in 1976 is very probably a consequence of the relative harshness of the previous winter. Notable also was the substantially lower density in early summer.

5.3.5 Biology Of *Mya* spp.

Size structures for *Mya* spp. are not clearly definable because of the relatively low density of the adults and the confusion caused by the 0-year classes (juveniles) of three species. Specimens smaller than about 20 mm are very difficult to assign to species and have therefore been tabulated separately (Appendix X). As a consequence, the number of specimens in the 0-year class for each species is unknown. However, the juvenile/adult ratio for *Mya* spp. averaged 28.7 and ranged from 1.4 to 88.0 in **April**, in contrast to July, when it averaged 0.7 and ranged from 0.1 to 1.3 (Table 18). Basically, the reduction in this ratio is a result of a considerable decrease in the abundance of juvenile *Mya*. Most of the loss appears to be a consequence of mortality; the slight increase in density of adults clearly doesn't account for the total reduction in juveniles. It appears, however, that growth of the juveniles was fairly rapid between **April** and **July**. Average shell length for the juvenile mode increased from 4.2 ± 1.0 mm in April to 11.9 ± 6.5 mm in July (Appendix Xc). Contrasting the virtual absence of specimens larger than

TABLE 18. DISTRIBUTION OF ADULT AND JUVENILE MYA SPP. IN THE INTERTIDAL ZONE AT GLACIER SPIT, CHINITNA BAY IN 1977

		Average Number per Core							
		April				July			
Tidal Elevation (ft)		+3.6	+2.5	+0.9	-1.2	+3.6	+2.5	+0.9	-1.2
Adults									
<u>Mya arenaria</u>		0.7	0.5	0	0.3	0.5	0.5	0.4	0.1
<u>M. priapus</u>		0	0.2	0.1	0.1	0.2	0.1	0.6	0.5
<u>M. truncata</u>		0	0	0	0.1	0	0	0.3	0.2
Total adults		0.7	0.7	0.1	0.5	0.7	0.6	1.3	0.8
Juvenile <u>Mya</u> spp		1.2	1.0	8.8	11.9	0.1	0.4	0.6	1.0
Juvenile/adult ratio		1.7	1.4	88.0	23.8	0.1	0.7	0.5	1.3

6.5 mm in April to the fact that 78 percent of the juveniles in July were larger than 6.5 mm (Figure 12) supports a hypothesis that the increase in size was due to growth and not solely differential mortality, at least initially.

Average shell length of adult Mya arenaria and M. priapus increased between April and July, but the sample sizes were small (Appendix Xd and Xe). Using Student's t-test, the increase from 67.0 mm to 73.7 mm for M. arenaria was not significant ($P > 0.10$), but for M. priapus, the increase from 26.9 mm to 46.5 mm was significant ($P < 0.05$). It seems imprudent to assume, without more direct evidence, that the latter increase is due solely to growth.

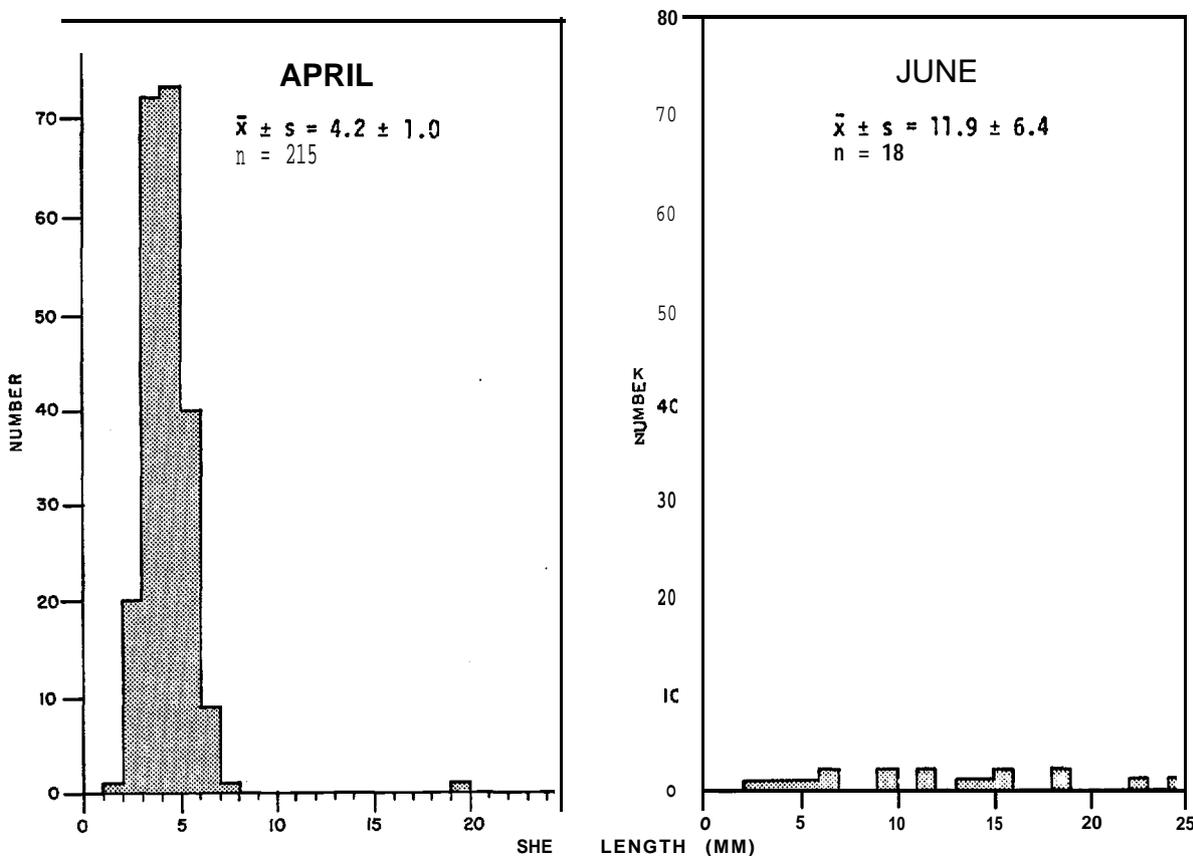


FIGURE 12 - SHELL LENGTH FREQUENCY HISTOGRAMS FOR JUVENILES OF MYA SPP. FROM GLACIER SPIT, CHINITNA BAY IN 1977

Additional information on the distribution and density of adult Mya spp. was obtained by counting siphon holes in a series of haphazard 1/16 m² quadrats at each sampling level (Table 19). Generally, this method produced more conservative density estimates than the core method, probably because the clams become distinguishable to species somewhat before they are large enough to produce a readily distinctive siphon hole. In fact, the quadrat data are probably more reliable than the core data for large clams because of the larger sampling area involved (0.0625 m² vs. 0.0078 m²), the larger number of samples collected (25 vs. 10 at each level) respectively, and the possibility that the corer may not satisfactorily sample large Mya. This interpretation is supported by a comparison of the means (\bar{x}) and standard deviations (s) of the two types of data. Examination of Appendix VI and Table 19 shows that, in all cases for adult Mya spp., s was larger than \bar{x} for core data and smaller than \bar{x} for quadrat data. This indicates that quadrat data were less variable.

A comparison of Mya densities among sampling levels based on quadrat data from April indicates that the 0.9 foot level had significantly higher density than +3.6 and -1.2 foot levels (P < 0.05 in all cases with the Mann-Whitney U test). However, the pattern of density is at odds with that estimated from core data (Table 19). In July, the only significant difference in density was between the +2.5 and the -1.2 foot levels (P < 0.05 in both cases). Density of adults appeared to be evenly reduced from the upper to the lower levels. Again, however, a curious discrepancy exists between the quadrat and the core data.

Based on the quadrat data, only the density increase from **April** to July at the +3.6 foot level was significant ($P < 0.01$). The overall difference in adult density between **April** and July (Table 19) was not significant ($P > 0.10$). The discrepancy between this finding and that based on core data is probably attributable to the great reduction in small **clams**, as discussed above.

It appears that M. arenaria is more successful at higher intertidal levels, whereas M. priapus and M. truncata are more successful at lower levels (Table 18). Mya truncata is a common subtidal species in several habitats. In **April** and **July**, juveniles were more dense at the lower levels than at upper levels. However, as indicated above, density of juveniles decreased considerably at all levels (in fact by an order of magnitude) between April and July (Table 18). This decrease was significant only at the lower two levels ($p < 0.05$ in both cases; Kruskal-Wallis analysis of variance). No such change was apparent in adult density. This is highlighted by the changes in juvenile/adult ratio.

5.3.6 Other Size And Density Data

Size data for the basket cockle (Appendix Xg) indicate that average size increased markedly from April to July' ($P < 0.001$; Kolmogorov-Smirnov two sample test). As in the case of Mya, a sharp reduction in density occurred over the same period (Table 20). It appears that the intertidal population is dominated by young specimens.

TABLE 19. DISTRIBUTION AND DENSITY OF ADULT MYA SPP. BASED ON HAPHAZARD CASTS OF A 1/16m² QUADRAT

Number per 1/16m ² quadrat	Elevation (ft)								
	6 April 77				30 July 77				
	+3.6	+2.5	+0.9	-1.2	+3.6	+2.5	+0.9	-1.2	
0	1	1	0	3	0	0	0	2	
1	2	2	0	4	2	4	2	4	
2	6	3	3	5	2	2	4	1	
3	5	6	3	3	3	1	3	5	
4	8	5	4	4	4	2	6	6	
5	1	2	3	3	4	6	1	0	
6	1	1	3	2	1	3	2	5	
7	0	2	3	1	2	1	2	1	
8	0	1	1	0	2	2	2	1	
9	0	0	1	0	1	2	2	0	
10	0	1	0	0	3	1	0	0	
11	0	0	2	0	1	0	1	0	
12	1	1	0	0	0	1	0	0	
13	0	0	2	0	0	0	0	0	
\bar{x}	3.4	4.2	6.0	2.9	5.5	5.2	4.8	3.6	
s	2.3	2.8	3.3	2.0	3.0	3.0	2.7	2.2	
No./m ²	53.8	67.8	96.0	46.7	87.7	83.2	76.2	57.6	
Overall mean					66.0/m ²				76.4/m ²
Estimated number of adults/m ² based on core data	101.8	101.8	38.2	63.6	114.8	127.4	216.4	114.7	
Overall mean					76.4/m ²				143.3/m ²

TABLE 20

DENSITY OF THE BASKET COCKLE CLINOCARDIUM NUTTALLI
IN THE INTERTIDAL ZONE AT CLACIER SPIT, CHINITNA BAY

<u>Elevation (ft.)</u>	<u>April</u>	<u>July</u>
+3.6	63.7	38.2
-1-2.5	50.9	76.4
+0.9	432.9	165.5
-1.2	345.8	178.2
$\bar{x} \pm s$	223.3 \pm 195.0	114.6 \pm 68.1

Similarly, size data for the small commensal clam Pseudopythina sp. (Appendix Xi) indicate a weak increase in average size (P < 0.10) from 3.2 mm to 5.0 mm. Average density was remarkably constant during this period (Table 21). This is probably a consequence of its apparent commensalism with burrowing species such as Echiurus, a behavior pattern that affords it considerable protection from severe predation pressures at the water-sediment interface. Highest densities appeared to occur at about MLLW.

TABLE 21

DENSITY OF THE COMMENSAL CLAM PSEUDOPYTHINA SP.
IN THE INTERTIDAL ZONE AT GLACIER SPIT, CHINITNA BAY

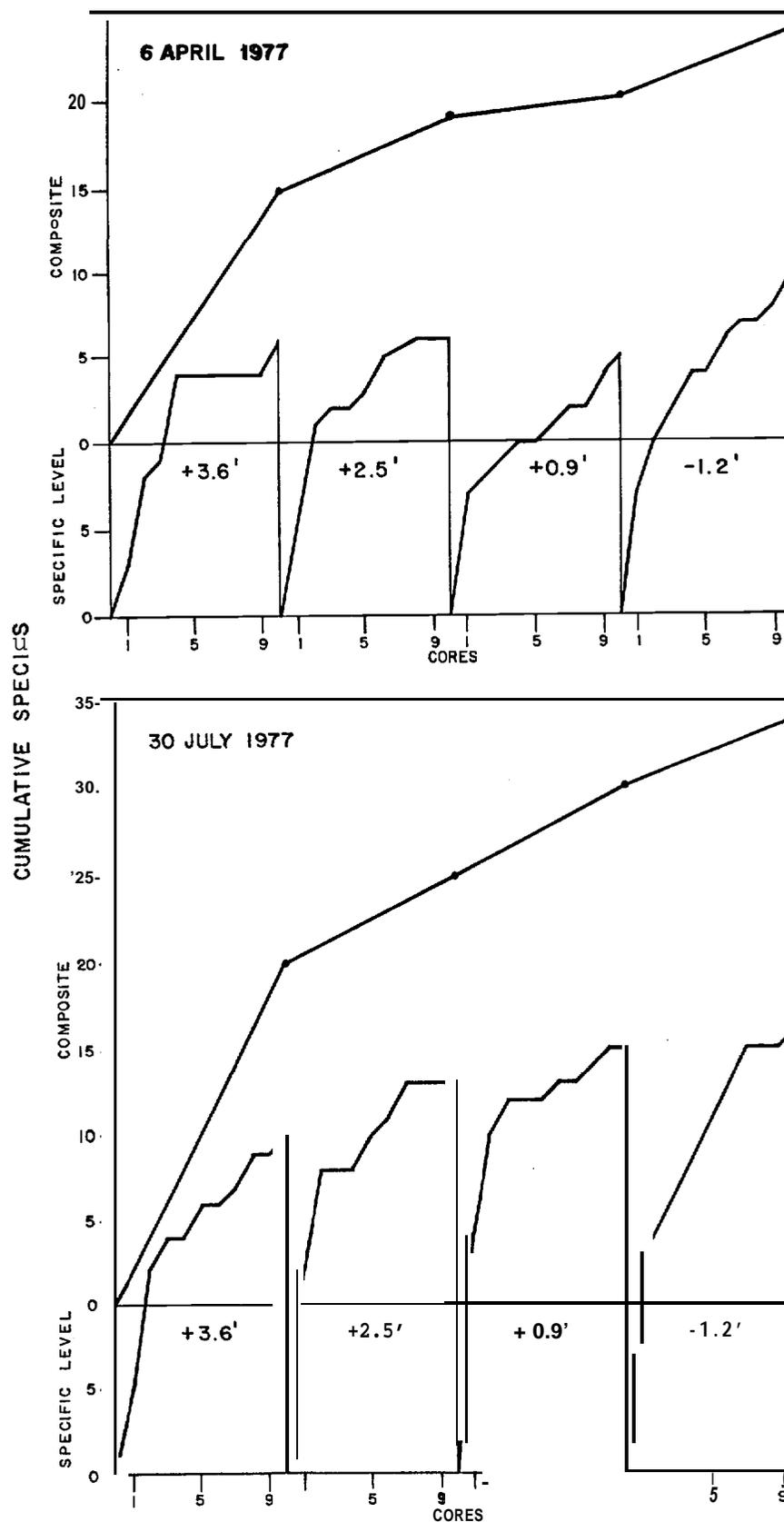
<u>Elevation (ft.)</u>	<u>April</u>	<u>July</u>
+3.6	89.1	89.1
+2.5	2 0 3 . 7	114.6
+0.9	229.2	216.5
-1.2	56.6	140.1
$\bar{x} \pm s$	144.7 \pm 84.6	140.1 \pm 55.0

5.3.7 Numerical Parameters

Numerical parameters used to describe the assemblage exhibited few strongly consistent patterns. Abundance, species richness and species diversity generally increased from upper to lower elevations in each survey (Table 15). However, abundance decreased at all levels between April and July ($P < 0.001$). Species richness and species diversity all increased markedly during the same period. These patterns in abundance and species richness corresponded in a reduction in the average number of specimens per species (N/S). In spite of a seasonal decline in abundance, biomass increased substantially at all but the highest level. The seasonal change in biomass progressed from a 10 percent reduction at the +3.6 foot level, through a 34 percent increase at +2.5 feet, to 325 percent and 259 percent increases at the +0.8 foot and -1.2 foot levels.

Species-area curves were constructed for each level and survey to provide insight into rates of species acquisition in the samples and the suitability of the sampling program. Generally, the curves for specific levels appeared to be leveling off, but none was asymptotic after 10 samples (Figure 13). This pattern was more apparent in July. However, it seems obvious that additional sampling effort only would have added a number of uncommon species to the lists compiled at each level during the respective sampling periods. This pattern accentuates the finding of high N/S ratios and low species diversity.

The composite species-area curves also generally tended to level off, but definitely were not asymptotic. This is to be expected because the sampling levels extend



**FIGURE 13 - SPECIES/AREA CURVES
FOR GLACIER SPIT, CHINITNA BAY**

across an elevation gradient and new species are expected to be encountered at the lower levels. In fact, the number of new species appearing below the upper level was greater in July, but seems rather modest for both sampling periods. This suggests a relative homogeneity in composition of the mud flat assemblage in the area examined.

6.1 SAND BEACH ASSEMBLAGES

The biological assemblages observed on the sand beaches exhibited many fundamental similarities in composition and structure. Many of the species were important at both sites, including the polychaetes Eteone nr. longs, Nephtys ?ciliata, Paraonella platybranchia and Scolelepis sp. A, and the gammarid amphipods Eohaustorius eous and Paraphoxus milleri (Table 1). Age structure data are not available for any for these species, but most appear to live for two years or less. Reporting on five species of haustoriids, Sameoto (1969a, 1969b) indicates ranges in longevity of 12 to 17 months; most were annuals. Hedgpeth (1957) reported that most sand beach organisms are annuals.

Many of the families, genera, and in some cases, the species, are characteristic components of unconsolidated intertidal assemblages in the Pacific and Atlantic Oceans (e.g., Withers 1977).

Many of the seasonal and elevational patterns observed for numerical parameters were similar for the two beaches (Tables 9 and 13). Levels of density, average number of species, species diversity, evenness and biomass were uniformly rather low at both locations. Sand beaches are generally characterized by low values for these parameters (Dexter 1969, 1972). At both beaches abundance, species diversity and biomass parameters generally increased from winter to summer, agreeing with the pattern described by Hedgpeth (1957) , and from higher to lower elevations as reported by Johnson (1970) . In addition, the average number of specimens per species increased from winter to summer, which was accurately reflected by decreases in the evenness index (E) over the same period. Keith and Hulings (1965)

found similar patterns on sand beaches on the Texas Gulf Coast.

In spite of the basic similarities, some **faunal** dissimilarities imply important differences between the areas. Specifically, the fauna at Deep Creek was dominated numerically by gammarid **amphipods**, viz. Eohaustorius, Gammaridae sp. A and Paraphoxus (Table 6). In contrast, the fauna at Homer Spit was dominated by **polychaetes** such as Scolelepis, and gammarids were only of marginal importance (Table 10). In terms of biomass, the fauna at Deep Creek was again dominated by Eohaustorius in both surveys whereas at Homer Spit, it was dominated by Scolelepis. Furthermore, the fauna at Homer Spit was somewhat richer than that examined at Deep Creek, biomass was appreciably greater, and the range of organisms, including a clam and a fish, was broader. Withers (1977) reported that the polychaete fauna on Welsh beaches was better developed in sheltered areas. Furthermore, he noted that, on exposed beaches, "only a very reduced fauna of crustaceans and small **polychaetes** was found." These facts lead to the impression that the fauna at Deep Creek was responding to a more rigorous environment and was more typical of exposed intertidal beaches. This impression was amplified by the strong dominance at Deep Creek by a haustoriid amphipod, a family often characteristic of exposed sandy beaches (Barnard 1969), the importance of another amphipod, Anisogammarus, and a mysid Archaeomysis, both typically intertidal species (Kozloff 1973). In contrast, the fauna at Homer Spit was characterized by increased importance of **polychaetes**, and the consistent appearance of characteristically subtidal forms such as the redneck clam (Spisula) and the sand lance (Ammodytes).

Pronounced annual variations in the abundance of organisms are characteristic of sand beaches (Hedgpeth 1957). The increases in abundance, species richness, species

diversity and biomass observed in this study in spring and summer are a consequence of a combination of reduced environmental stress, growth, and recruitment. Higher species richness indicates that several species are attempting to colonize the intertidal zone during this relatively mild period. Size structures, when available, indicated that many juvenile specimens were present, and growth was also apparent for at least **one** species (Eohaustorius).

It is probable that several factors are responsible for lower levels of abundance species richness and biomass in the winter. Increased wave action undoubtedly raises mortality rates for species living near the water-sand interface. March samples from Homer Spit taken immediately after a storm suggested that density of some polychaetes was reduced. However, densities of Eohaustorius and Paraphoxus were not appreciably affected, and Scolelepis, which lives buried deeply in the sand, increased substantially during this period. Keith and Hulings (1965) reported that sand faunas on the Texas Gulf Coast were not appreciably affected by the waves of Hurricane Cindy, in 1963. Low winter temperatures undoubtedly reduce metabolic rates and feeding activities thus slowing growth and reproductive activities. Woodin (1974) states that many polychaetes die after spawning and this may account in part for the seasonal variations in density observed at both beaches. Increased sediment instability associated with storms is likely to reduce success rate in recruitment, but this may be of little importance in winter.

The precise role of predation in the sand beach assemblages is, at present, still unclear. Predation pressure appears low, but has not been assessed in detail. The only infaunal predator recognized so far is the polychaete Nephtys (Kozloff 1973, Green 1968), which probably feeds on Scolelepis. Pressure from shorebirds appears minimal, even

during the peaks of migration. Several species are known to feed on amphipods on sandy beaches (Sameoto 1969a; Dave Erikson, personal communication). Species observed on local sandy beaches include Semipalmated Plovers (Calidris pusilla), Rock Sandpipers (C. ptilacnemis), Dunlin (C. alpina), Western Sandpipers (C. mauri) and Sanderlings (C. alba). However, most prefer other habitats. Glaucous-winged Gulls (Larus glaucesens) and Mew Gulls (L. canus) are commonly observed foraging on the exposed low-tide terrace; they appear to capture the large polychaete Nephtys, amphipods, the helmet crab Telmessus, the sand lance Ammodytes, and also occasionally larger clams. When the low-tide terrace is underwater, several species of diving ducks (e.g., Greater Scaup (Aythya marila), Oldsquaw (Clangula hyemalis), White-winged Scoter (Melanitta deglandi), Surf Scoters (M. perspicillata) and Black Scoters (M. nigra) move in to feed. Apparently spring is the period of greatest utilization by sea ducks, but even then usage is minor. Predation pressure from birds is somewhat reduced in the winter.

Several demersal fishes and epifaunal invertebrates, all potential predators, have been collected on the low-tide terrace during periods of submergence. The fish included Pacific staghorn sculpin (Leptocottus armatus), brown Irish lord (Hemilepidotus spinosus), starry flounder (Platichthys stellatus), butter (Isopsetta isolepis) and English sole (Parophrys vetulus), Dolly Varden trout (Salvelinus malma), steelhead trout (Salmo gairdneri), sand lance and sandfish (Trichodon trichodon) (personal observation). The epifaunal invertebrates were mainly crustaceans, such as Dungeness, tanner, and helmet crabs and gray shrimp (Crangon sp.). Our subtidal observations indicate most of the fish and infaunal invertebrates move into deeper water during the winter months. Virnstein (1977) has shown that crabs and fish can exert strong control on infaunal population of polychaetes and clams on soft substrates. He further points out that

the importance of predation cannot be determined without experimental manipulation.

The importance of competition as a factor influencing composition of the sand beach faunas and the distribution and abundance of their component species is difficult to assess based on the existing data. Sand beaches are strongly influenced by various physical stresses and thus are typical of physically controlled habitats as defined by Sanders (1968), wherein biological interactions such as competition and predation are thought to be relatively unimportant. Slow moving or juvenile organisms that live near the water-sand interface may be strongly influenced by storm surf or temperature extremes during low tides. The large decrease in the density of Paraonella noted after a winter storm may be evidence of this. Furthermore, Hedgpeth (1957) suggests that food supplies are not limiting on sand beaches. Combining these possibilities with observed low species richness and densities, it therefore seems plausible to consider interspecific competition inconsequential.

However, both Virnstein (1977) and Woodin (1974) point out the danger of ignoring biological interactions in physically controlled habitats. Interspecific competition in protected intertidal soft substrates has been shown for several species (e.g., Woodin 1974, Fenchel 1975, and Ronan 1975), but not on exposed sand beaches. The dominance of environmental stress in these habitats must be examined from the viewpoint of juveniles as well as adults of each species, as most adults live in more protected circumstances on soft substrates. For instance, recruiting juveniles of the polychaete Scoelelepis face a much more rigorous environment near the water-sand interface than the deeply buried adults. It appears that the adults migrate vertically in the sand, moving upward to richer food concentrations during calm weather and downward in response to physical stresses and

disturbances. Under such circumstances, it is possible that intraspecific competition for food and space could occur at the deeper, more protected levels, especially during the winter. However, as Scoelelepis appears to be the only deep burrowing deposit feeder found on exposed sand beaches, interspecific competition seems unlikely.

The trophic structure of the sand beaches is not well understood, but a tentative food web is indicated in Figure 14. The main source of energy for the assemblage appears to be detritus, which the primary consumers ingest mainly for the adhering bacteria. The two major categories of detritivores recognized in the sand beach assemblages are suspension feeders and deposit feeders. The former, including a mysid Archaeomysis and the clams Spisula, Siliqua, and Tellina lutea, feed on organic particles in suspension or at the water-sand interface. However, a greater proportion of the energy appears to pass through polychaetes and gammarid amphipods. The gammarid amphipods Eohaustorius and Paraphoxus are probably selective deposit feeders, burrowing to feed on sand grains and organic particles of specific sizes. The polychaete Scoelelepis, which ingests large quantities of sand, is probably a non-selective deposit feeder.

The primary consumer groups appear to contribute to both marine and terrestrial systems by serving as forage items for birds and fish. The most important linkages seem to go to fish and shorebirds. Based on the low standing stocks, low levels of observed bird predation (even during spring migration) , and the relative inaccessibility of a major biomass component (the deep burrowing polychaete Scoelelepis) to the major shorebirds (which feed chiefly at or near the sediment surface) , it appears that the sand beach habitat contributes only minimally to bird productivity of Lower Cook Inlet. Its importance to the **subtidal** forms (fish, crabs, and shrimp) is unclear at present. However,

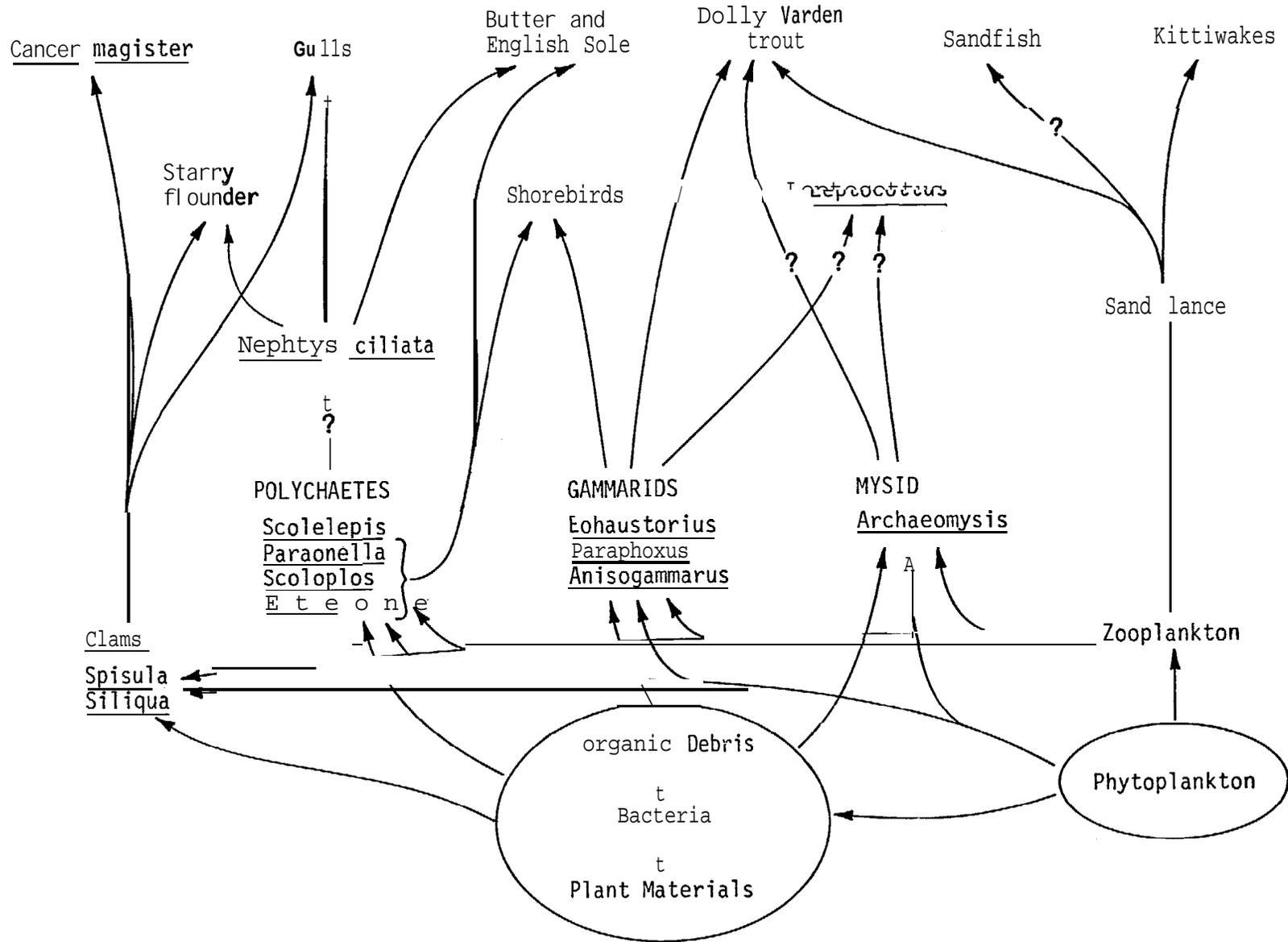


FIGURE 14 - GENERALIZED FOOD WEB FOR SAND BEACHES AT HOMER SPIT AND DEEP CREEK

productivity appears to be low in comparison with mud beaches.

A comparison of **infaunal** data from several sand beaches on the east side of Lower Cook Inlet suggests that the sand beach assemblages are quite variable spatially and possibly temporally (Table 22). Only 17 percent of the species were found at more than three of the stations. Only Eohaustorius and Paraphoxus were found on all occasions. Temporal patchiness cannot be examined because of differences in sampling areas and methods at Homer Spit and Deep Creek. Samples for 1976 were collected with a much smaller, shorter core tube than in 1977, and fewer samples were collected in 1976, so deep burrowing forms such as Scolelepis, and uncommon or patchy species were not sampled adequately in that survey.

Two patterns seem rather well-defined. Overall, **polychaetes** decrease and crustaceans increase in importance on the beaches moving from Homer to Deep Creek. As noted above, this seems to reflect a gradient in physical energy, with Deep Creek being subjected to stronger, more consistent current action, as well as higher turbidity, colder temperatures, lower salinities and more ice.

Further insight into this physical stress gradient **is** provided by comparing the species composition of Homer Spit and Deep Creek with that of a **subtidal** sand habitat at the A.R.Co. **C.O.S.T.** well site **in** the middle of Lower Cook Inlet (~60 m deep) . There **is** a surprising but definite resemblance between the intertidal sand assemblages and that described for unstable **subtidal** sand substrates (Table 23; Dames & Moore 1978). Forty-five percent of the species considered important at Deep Creek and eighty percent of those at Homer Spit were also common **at** the **C.O.S.T.** well site. The **polychaete** Scolelepis and a **gammarid amphipod**

TABLE 22. SPECIES COMPOSITION AND DENSITY (NO./M²) AT SAND BEACHES ON THE EAST SIDE OF LOWER COOK INLET. BEACHES ARE ARRANGED FROM SOUTH TO NORTH.

AX	Homer Spit 1977	Homer Spit 1976	Bishops Beach 1976	Whiskey Gulch 1976	Deep Creek 1977	Deep Creek 1976	Clam Gulch 1976
	(78%)	(29%)	38%	1%	(13%)	1%	10%
<u>Polychaeta</u>							
<u>Abarenicola</u> sp	0	0	0	0	6.4	0	0
<u>Capitella capitata</u>	25.5	0	0	0	9.6	0	0
<u>Chaetozone setosa</u>	0	0	0	0	6.4	0	0
<u>Eteone</u> nr <u>longa</u>	3.2	0	0	0	9.6	37.8	0
<u>Magelona</u> ? <u>sacculata</u>	*	0	113.4	0	0	0	0
<u>Nephtys</u> ? <u>ciliata</u>	22*3	37.9	37.9	21.4	9.6	0	0
<u>Paraonella</u>							
<u>platybranchia</u>	213.3	0	0	0	12.7	75.8	75.8
<u>Scorelepis</u> sp A	547.5	0	0	32.5	92.3	0	12.6
<u>Scoloplos armiger</u>	0	2.8	0	0	31.8	75.8	1.0
<u>Spio filicornis</u>	0	4.0	0	0	0	75.8	25.3
<u>Spiophanes bombyx</u>	3.2	15.8	75.8	0	0	0	0
Crustacea	(6%)	(59%)	(63%)	(84%)	(85%)	(84%)	(90%)
<u>Anisogammarus confervicolus</u>	0	0	0	1.8	0	0	0
<u>Anonyx</u> sp	0	0	0	1.8	0	0	0
<u>Archaeomysis greboitzkii</u>	0	0	0	0	3.2	0	0
<u>Atylidae</u> , unid.	0	0	0	0	3.2	0	0
<u>Crangon alaskensis elongata</u>	12.7	0	0	0	0	0	0
Cumacea, unid.	0	151.5	0	10.8	0	0	0
<u>Eohaustorius eous</u>	28.7	37.9	75.8	151.5	648.4	1363.6	947.0
<u>Gammaridae</u> , unid.	0	0	0	0	388.3	0	12.6
<u>Hippomedon</u> sp	0	151.5	22.3	0	0	0	0
<u>Lamprops carinata</u>	4*5	0	0	0	0	0	0

547

TAXA	Homer Spit 1977	Homer Spit 1976	Bishops Beach 1976	Whiskey Gulch 1976	Deep Creek 1977	Deep Creek 1976	Clam Gulch 1976
Crustacea, cont.							
<u>Lamprops quadriplicata</u>	79.6	0	0	0	19.1	0	0
<u>Lamprops sp</u>	3.2	0	0	0	0	0	0
<u>Paraphoxus milleri</u>	19.1	37.9	75.8	108.2	19.1	37.8	25.3
<u>Synchelidium sp</u>	12.7	0	0	0	6.4	0	0
Pelecypoda	(0.6%)	(18%)					
? <u>Macoma sp</u>	0	37.9	0	0	0	0	0
? <u>psephidia lordii</u>	0	37.9	0	0	0	0	0
<u>Spisula polynyma</u>	6.4	0	0	0	0	0	0
Pisces	(0,3%)						
<u>Ammodytes hexapterus</u>	3.2	0	0	0	0	0	0

TABLE 23. COMPARISON OF DENSITIES (NUMBER/M²) FOR IMPORTANT SPECIES AT VARIOUS SITES ON UNSTABLE SAND HABITATS IN LOWER COOK INLET

	Deep Creek	Homer Spit	ARCO site	
			Ocean Ranger	Control
Polychaetes				
<u>Capitella capitata</u>	6.4	0	0	0
<u>Chaetozone setosa</u>	0	0	5.0	5.4
<u>Eteone nr longa</u>	21.3	3.2	0.6	92.9
<u>Nephtys ?ciliata</u>	6.4	6.4	12*2	35.7
<u>Ophelia limacina</u>	0	0	45.0	125.0
<u>Paraonella</u>				
<u>platybranchia</u>	12.7	132.6	0	0
<u>Polygordius</u> sp	0	0	7.8	407.1
<u>Scolelepis</u> sp A	47.7	402.1	423.9	160.7
<u>Scoloplos armiger</u>	18.0	2.1	61.7	33.9
<u>Sphaerosyllis pirifera</u>	0	0	0	25.0
<u>Spiophanes bombyx</u>	0	1.1	185.6	2410.7
<u>Streptosyllis</u>				
nr <u>latipalpa</u>	0	0	7.2	12.5
Crustaceans				
<u>Anisocammarus</u>				
<u>confervicolus</u>	4.3	0	0	0
<u>Archaeomysis</u>				
<u>grebnitzkii</u>	1.1	0	0	0
<u>Eohaustorius eous</u>	504.7	20.2	0	0
Gammaridae sp A	129.4	0		
<u>Orchomene cf pacifica</u>	0	0	3.9	17.9
<u>Paraphoxus milleri</u>	19.1	38.2	56.1	14.3
Clams				
<u>Astarte</u> sp	0	0	0.6	25.0
<u>Glycymeris subobsoleta</u>	0	0	2.2	50.0
<u>Liocyma fluctuosa</u>	0	0	31.7	58.9
<u>Spisula polynyma</u>	0	7.4	0.6	3.6
<u>nuculoides</u>	0	0	19.4	44.6
Gastropod				
<u>Propebela</u> spp	0	0	16.1	7.1
Sand dollars				
<u>Echinarachnius parma</u>	0	0	22.2	17.9
Fish				
<u>Armodytes hexapterus</u>	0	7.4	c	c
Overall Average Density	788	726	1017	3852

Paraphoxus were frequently considered dominants at all locations. Other species that were common at all locations include the polychaetes Eteone nr. longs, Nephtys ?ciliata, and Scoloplos armiger. It is tempting to speculate, in view of the physical gradient, that the faunal differences observed between the various sites represent sequences in the successional development of a sandy substrate, as suggested by Johnson (1970). This could not be shown without experimental manipulation, however.

6.2 MUD FLAT ASSEMBLAGES

Our studies so far have indicated that, in contrast to sand beaches', the mud flat off Glacier Spit, Chinitna Bay, supports a large standing crop of suspension and deposit feeders, has higher species richness, and appears to be highly productive. However, spatial, seasonal and annual variability were considerable, being influenced strongly by weather conditions and predation. Species richness, species diversity and biomass were greatest in the summer, whereas abundance was lowest in summer (Table 15) . This apparent paradox is attributable to the large reduction in the abundance of juveniles of the clams Macoma balthica and Mya spp. between April and July; most other species increased in abundance during the same period (Table 14) .

The fauna was dominated heavily by the clams Mya Spp. and Macoma balthica, which comprised more than 50 percent of the individuals and 90 percent of the wet biomass and dry tissue weight in both surveys (Tables 14 and 17) . Macoma was by far the most abundant, but contributed only 10 to 15 percent of the biomass. Three other visually conspicuous species of marginal importance were an echiurid Echiurus echiurus alaskanus, a large polychaete Nephtys sp. , and the basket cockle Clinocardium nuttallii, all of which also contributed marginally to biomass.

Ten species exhibited densities exceeding 100 individuals/m² in at least one survey. These included, in order of importance, Macoma, Mya spp., Nephtys, Spio, Potamilla, Clinocardium, Pseudopythina, Tritella, Eteone and Capitella (Table 14). All of the worms except Nephtys increased in abundance substantially from April to July, whereas that worm and all of the clams became less abundant. All of the species exhibiting increased abundance are thought to be annuals, at least in this habitat. In contrast, all of the species that declined, including Nephtys, appear to be perennials (Thorson 1957).

The species that appear to represent the mature stage, or highest level of development, of this mud flat assemblage are the clams Mya, Macoma, Pseudopythina, the polychaete Nephtys and the echiurid Echiurus. The present rarity of adult Clinocardium in the intertidal zone suggests that it does not survive harsh winters at these elevations in this location. However, long-time resident Wayne Byers indicated that adult cockles were abundant on these flats prior to the uplift resulting from the 1964 earthquake (personal communication). Mya spp. and Echiurus construct semi-permanent burrows which impart a characteristic appearance to the mud flats on the west side of Lower Cook Inlet (Figure 10).

The richness of this mud flat assemblage is indicated by the density and biomass of its constituent species, particularly the dominants. For instance, in April, when the population was dominated by the 0-year class, Macoma densities ranged from 4250/m² to 5350/m² (Appendix VI) and whole wet weight ranged from 340 g/m² to 550 g/m² (Appendix VII). Such densities are among the highest recorded for Macoma (Green 1968, Tunnicliffe and Risk 1977), and this is particularly notable in view of the high percentage of animals at least one year old during the summer (Figure 11) .

The contrasting seasonal patterns of abundance for the major clams and the **polychaetes** seem to indicate differences in reproductive cycles. Density of the three main clam taxa decreased markedly from April to July. Moreover, the 0-year class strongly dominated the age structures for Macoma, Mya spp. and Clinocardium in the April samples but was strongly reduced in all cases by July. The implication is that recruitment occurs in late summer, fall or winter. This hypothesis is partially supported for Macoma by data from the Irish Sea for reproductive condition from Chambers and Milne (1975), and for Mya truncata by Thorson (1957) . Surprisingly, however, Chambers and Milne (1975) observed heavy recruitment in July, four months after the local adult population was spawned out.

Myren and Pella (1977) found no seasonal changes in density for larger specimens of M. balthica at Valdez. The data for large specimens of Macoma and Mya spp. from Glacier Spit generally support that finding, and suggested that the adult size classes are much more stable than the 0-year class.

Density of the **polychaete** populations increased considerably from April to July. The July samples were strongly dominated by newly settled specimens, as was the case on the sand beaches. This pattern suggests late spring or early summer spawning.

It seems probable that both physical and biological factors are important in determining the density of the organisms living in the mud flats at Glacier Spit. Physical conditions are severe, especially near the water-sediment interface where temperature and salinity fluctuate widely and ice scouring and crushing can be substantial. In addition, predation pressures and intra- and interspecific competition for food and space are probably intense, espe-

cially in the spring, when maximum densities of young clams are concentrated in the upper few centimeters of sediment and high numbers of migratory birds exploit the mud flats. In addition, predation by adult clams on larval, metamorphosing and settling juvenile clams is probably intense during major periods of recruitment.

Predation seems to exert a strong influence on the density of several species, such as Macoma balthica, Mya Spp. and Echiurus. A broad variety of predators exploit the mud flats (Figure 15) . Diving ducks (**scoters, scaup and Oldsquaw**) , gulls and shorebirds appear to be major predators on clams and **polychaetes**. Diving ducks and shorebirds are most abundant during spring migration and seem to concentrate on Macoma and Mya. Judging from the reductions of nearly 50 percent and 70 percent in the densities of Macoma and Mya, respectively, these predators **are** fairly effective. The changes in size structure indicate that juveniles, located near the sediment surface, are most frequently utilized. Gulls were observed foraging on the mud flats during both day and night low tides, and their egesta and shell debris indicate that they feed mainly on barnacles, Clinocardium, and crabs; large worms such as Nephtys are probably also taken frequently.

The **only** resident predator of any importance observed in the study area was the **polychaete** Nephtys sp. The population of this perennial included specimens up to 10 cm in length, but was strongly dominated by the small, younger animals. The importance of this species is poorly understood. The few feeding observations made were for adults, and most had empty alimentary canals. The small number of feeders had all fed on adult Echiurus; one specimen contained two prey. Based on available prey and habits, it seems probable that juvenile Nephtys feeds on juvenile Echiurus and small **polychaetes**.

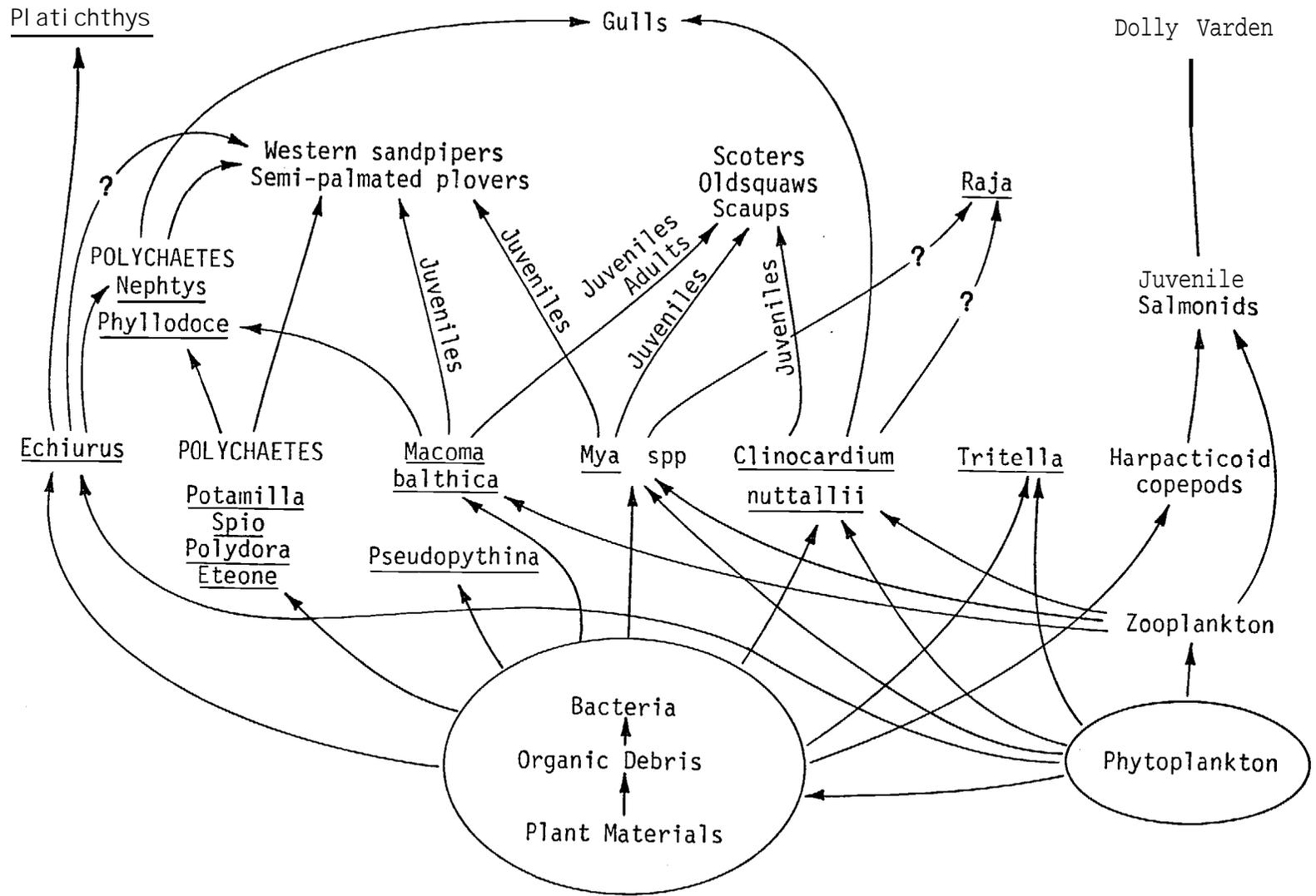


FIGURE 15 - GENERALIZED FOOD WEB FOR MUD FLAT AT GLACIER SPIT

Gastropod predators, particularly small **opisthobranchs**, are frequently common **locally** on mud substrates and on more temperate mud flats. However, they were very uncommon during this survey.

Data are presently not available to describe the function of several predators, but some speculation is permissible based on other studies or observations. Excavations and shell remains observed while diving in Cottonwood Bay suggest that skates (**Raja**) may move into shallow bays and feed on **Clinocardium**. Starry flounder are reported to feed on **Echiurus** in the Bering Sea (**Feder**, personal communication). Other potential predators important to **macrofaunal** forms include **Dungeness** (**Cancer magister**) and tanner crab, rock sole (**Lepidopsetta bilineata**), and Pacific staghorn **sculpin**.

As indicated above, competition for food and space may be important in determining densities and growth rates of several species, particularly the clams **Macoma** and **Mya** spp. The feeding activities of dense adult clams may strongly reduce success of recruits attempting to settle, so that suitable space is limiting for larvae. Furthermore, food and space are somewhat synonymous for **Mya** and **Macoma** and, at high densities, available food may become limiting.

Several types of mud flats have been observed in **southcentral** Alaska; all are dominated by clams and generally they differ sharply from those described or observed in Washington (**Kozloff** 1973) or California (**Ricketts** and **Calvin** 1962). **Species** richness is rather lower, reflecting the absence or paucity of a number of higher taxa. **Southcentral** Alaskan mud flats generally lack burrowing shrimp (e.g., **Callianassa** and **Upogebia**), gammarid amphipods and **isopods**, deposit feeding or predatory gastropod (e.g., **Hydrobia** or **Aglaia**) and commensal fish (e.g., **Clevelandia**).

Southcentral Alaskan mud flats appear to have greater affinity to similar habitats on the Atlantic Ocean, which also support high densities of Macoma balthica and/or *Mya* spp. These species dominate on many mud flats in Lower Cook Inlet, and the burrow building Echiurus is frequently an important structural component. On some mud flats, such as the Dayville flats in Valdez (Feder, personal communication) and Mud Bay in Homer (personal observation), *Mya* and Echiurus are uncommon, reducing the permeability of the sediments.

A number of mud flats support beds of eelgrass (Zostera marina), but intertidal stands are frequently limited by winter ice.

The generalized trophic structure proposed for the mud flat (Figure 15) appears to be based on detrital material from marine and terrestrial systems. It is considerably more diverse than that for sand beaches. Griffiths (personal communications) indicates that the bacterial flora observed in the water column on the west side of the inlet suggests that terrestrial plants may be a major source of organic debris. The detritus, associated inorganic particles, bacteria and protozoans are ingested by suspension and deposit feeders (Jorgenson, 1966), but mainly the bacteria and protozoans are digested and assimilated (Johannes and Satomi 1966). Nearly all of the infaunal animals collected at Glacier Spit were detritivores; both suspension and deposit feeders were common but suspension feeders seem to dominate. Non-selective deposit feeders such as Abarenicola were uncommon.

Nearly all the predators observed were transients representing other systems, and were mainly effective only in spring and summer. However, several overwintering duck species are heavily dependent on mud flats. The fish, crabs

and ducks move onto the intertidal flats during high tides, and the shorebirds move in during low tides. Commercially, the most important of these interactions appears to be that of juvenile salmon and harpacticoid copepods (Sibert et al. 1977, Kaczynski et al. 1973). The consequence of this concept is that a very large proportion of the tissue produced on the flats is exploited by predators from other systems. This is a particularly important concept on the west side of the Inlet because of 1) the richness of the mud flats, 2) the large proportion of mud flat habitat in the intertidal zone and, 3) the potential susceptibility of this assemblage to oil pollution.

A preliminary assessment of secondary production can be made using data for density, growth and biomass data and the predation hypotheses. Nearly all species exhibited sizeable changes in density between April and July. With the notable exception of Macoma, most species exhibited relatively large increases in standing crops. For Macoma, density decreased nearly 50 percent concurrent with a small decrease in standing crop. Average size of all the populations appeared to increase during this period. During this same period, it is probable that predation pressures were intense. Despite predation, whole wet weight increased during this four month period from 2.3 kg/m² to 4.0 kg/m². The 74 percent increase in biomass during a period of intense predation indicated moderately high net production.

6.3 FAUNAL COMPOSITION OF GRAVEL UPPER BEACHES AND SCoured BOULDER FIELDS

Gravel/cobble upper beaches and scoured boulder fields were frequently associated with the soft substrates and so were examined qualitatively to develop a general idea of their faunal composition and structure. These areas were quite impoverished, a condition which Kozloff (1973) reports

is normal. However, particularly during summer, the lower levels of gravel and cobble substrate characteristic of upper beach areas throughout much of Lower Cook Inlet appear to support moderate densities of two scavengers, namely, the gammarid amphipod Anisogammarus confervicolus and the isopod Gnorimosphaeroma oregonensis. These organisms are most abundant in areas where ground water from the upper beach seeps onto the beach. There, they aggregate mainly under large cobbles that rest in a manner allowing water to stand or pass gently under them. Generally, these species should be considered as cryptic rather than infaunal as they do not appear to live interstitially in the gravel. Nematodes appear to be the common infaunal form.

These species are also characteristic of the scoured boulder/cobble fields occurring at about MLLW. However, these areas are not subject to the continuous grinding that occurs in the gravel beach, and therefore are capable of supporting young populations of pioneer species such as barnacles (Balanus spp.) and mussels (Mytilus edulis). Generally, these populations do not survive a harsh winter, but annual replacement appears to be fairly reliable. The last two winters have been quite mild, however, so many such areas in Lower Cook Inlet support two year classes of barnacles and mussels.

These species appear to occupy positions low in the food web, and are probably mainly dependent upon phytoplankton (barnacles and mussels), or plant and animal debris (isopods and amphipods). However, casual observations suggest that a number of invertebrate, bird and fish species heavily utilize these resources for food. The nudibranch Onchidoris bilamellata and the snail Nucella emarginata compete for the barnacle and mussel resources. Onchidoris appears to be more successful in the less stable areas.

Shorebirds, mainly sandpipers, turnstones and plovers, put considerable predation pressure on these habitats, particularly during spring migration, when utilization is intense. The Rock Sandpiper, a winter resident, appears to be particularly important. Our observations during the winter suggest that this species is using these resources during both day and night low tides. The occurrence of night feeding by shorebirds in winter does not appear well known. However, the energetic argument appears strong, considering the combination of short day length, available low (feeding) tides, the possibility of reduced prey density and higher metabolic rates for resident birds during winter months.

Several invertebrate and fish species have been collected in beach seine hauls just below these habitats and it can be assumed that many of these probably feed there. The main invertebrates are adult and juvenile Dungeness crabs (Cancer magister), adult helmet crabs (Telmessus cheiragonus) and gray shrimp (Crangon alaskensis). Juvenile Dungeness crabs are fairly common in the boulder/cobble field during the summer. The main fish species observed include the sand lance (Ammodytes hexapterus), Pacific staghorn sculpin (Leptocottus armatus), starry flounder (Platichthys stellatus), and flathead sole (Hippoglossoides elassodon). Specific food habits have not been investigated in this area.

6.4 PRELIMINARY DISCUSSION OF THE POTENTIAL EFFECTS OF OIL POLLUTION

The two major potential types of oil pollution of concern in Lower Cook Inlet are catastrophic spills of crude oil and chronic pollution by refined petroleum or refinery effluents. Chronic pollution is a concern chiefly on the eastern shore of the Inlet since most onshore facilities are

planned for that side (Warren, 1978). This would result from increased boat traffic to supply and support facilities and, in the event of development and production, from the operation of various onshore facilities related to treatment and transfer of oil and gas. During the exploration phase, chronic pollution from boat activities should be minimal, but during development and production, it could become significant. General sites being considered for construction of onshore facilities include the western tip of the southern Kenai Peninsula, between Port Graham and Port Chatham, and Anchor Point, just north of Kachemak Bay. Facilities could include crude oil terminals, production treatment facilities, and liquification and terminal facilities for natural gas. Suitable sites on the southern Kenai are located on or near very productive embayments and estuaries. The Anchor Point site would include an important river mouth and wetland.

A regional assessment of coastal morphology has been used to predict behavior of oil spills in Lower Cook Inlet and to develop a classification of the susceptibility of local coastal environments to oil spills (Hayes, Brown and Michel, 1977). This classification is based primarily on geological features and sediment characteristics as they relate to interactions with crude oil. It provides a useful starting point in assessing potential impacts from oil pollution, but it is necessary to temper the assessments with the idea that the major incentive for investigating potential effects of oil pollution is protection of biological assemblages. A point sometimes overlooked is that a ranking of biological assemblages by either importance or susceptibility to oil pollution does not always agree closely with the classification based on geological characteristics proposed by Hayes et al. (1977).

For the purposes of their assessment, Hayes et al. (1977) divided the 1216 km of examined shoreline into erosional, neutral and depositional categories (45, 38 and 17 percent, respectively). Because of the complex structure of the beaches, it is difficult to subdivide these categories into **bedrock**, **boulder fields**, **gravel**, **sand** or **mud**. The upper beach face in Lower Cook Inlet (Figures 2 and 3) is most commonly composed of **gravel**, or a mixture of **gravel**, **sand**, **cobbles**, and **boulders**. However, adjacent low-tide terraces are usually **mud**, **sand**, **boulders** or **bedrock**. The distinct difference in substrate between upper beach face and low-tide terrace on most beaches in Lower Cook Inlet makes it somewhat difficult to apply the Hayes assessment of environmental susceptibility locally. For instance, most flat fine-grained sandy beaches [given a susceptibility ranking of 3 on a scale of 1 (low) to 10 (high)] , are bordered by a beach front of gravel or mixed sand and gravel (susceptibility rankings of 7 and 6, respectively). This problem is further complicated by assessment of biological susceptibility. Gravel or mixed sand and gravel beaches generally support only impoverished assemblages of small crustaceans and are therefore probably of lower importance than sand beaches which often support important populations of razor clams. Furthermore, it is important to consider the levels of tolerance or susceptibility to contamination of the organisms in an assemblage, and the importance of the assemblage to other assemblages or systems. Clearly then, several factors must be integrated to develop a satisfactory assessment of susceptibility.

6.4.1 Sand Beaches

Beaches with sandy low-tide terraces border about 50 percent of Lower Cook Inlet. They are concentrated on exposed portions of the Inlet, especially in its northeastern quadrant. Hayes et al. (1977) indicated that since these

beaches are generally flat and hard-packed, they are relatively impenetrable to oil and thus have a fairly low susceptibility ranking. However, oil stranding during a falling tide may penetrate into the sediment (especially the water-soluble, toxic fractions) and come into contact with the infaunal forms (Anon. 1975). Furthermore, extensive burial of stranded oil can occur, increasing the residence time on polluted beaches. Such burial can induce anaerobic conditions, delaying microbial degradation.

The biological assemblages most commonly observed on sand beaches in Lower Cook Inlet are dominated by burrowing polychaetes, small crustaceans (gammarid amphipods and mysids) and razor clams. All are known to be somewhat sensitive to crude and petroleum products. Generally, standing stocks are low and the contribution of sand beaches to other systems appears low. However, beaches supporting dense clam populations are important to sport and commercial clamming enterprises. Recovery of the worm and crustacean populations would be rapid following contamination, but for clam populations, recovery would be very slow, possibly requiring decades.

6.4.2 Gravel And Sand Upper Beaches

As pointed out above, gravel or mixed sand and gravel upper beaches border a large proportion of the shoreline in Lower Cook Inlet. Hayes et al. (1977) indicate that oil arriving on such beaches can penetrate to considerable depths, especially on gravel, or can be buried, and thus residence periods can be great. Clean-up would be difficult without large-scale removal of sediments. Such beaches are therefore highly susceptible (ranking of 7 and 6, respectively) to oil pollution. In the Straits of Magellan, oil from the Metula spill formed thick asphalt pavement on low-tide terraces of mixed sand and gravel (Hayes et al. 1977); this formation was highly resistant to degradation.

The biological assemblage most frequently observed is impoverished, mainly including nematodes, one gammarid amphipod and one isopod species. The sensitivity of these species to crude oil is **unknown**, but, as they are all short lived, they probably could recovery fairly rapidly. However, widespread contamination could lead to a lengthy recovery period since both the gammarid and the isopod are brooders, having no pelagic larvae. Recolonization would depend upon migration rates. Our observations so far suggest that this assemblage supports limited secondary production and contributes little to other systems.

6.4.3 Scoured Boulder Fields

The extent of scoured boulder fields on the **low-tide** terrace is unclear, but they may be located primarily on spits and below eroding **scarps**. Hayes et al. (1977) do not specifically rank this type of **habitat**, and the basic sediment is often mixed sand and gravel. Therefore, many of the same considerations apply.

These boulder fields support a more diverse biotic **assemblage, however**, because of the high proportion of solid substrate. Nevertheless, most of the animals are pioneer species and the populations are largely dominated by young organisms. These conditions are a consequence of scouring and abrasion. Juvenile barnacles and mussels are often dominant species and although production may be moderate, biomass is low. The contribution of this assemblage is not great, although overwintering Rock Sandpipers appear to feed in such areas. Because of their small size, many of the animals in this habitat would be susceptible to smothering by crude oil. However, natural scouring could be expected to facilitate clean-up and recovery would probably be rapid (perhaps within two years).

6.4.4 Mud Flats

Mud flats, variously referred to by Hayes et al. (1977), as muddy tidal flats, protected estuarine tidal flats and rias, border about 35 percent of the total shoreline of Lower Cook Inlet and nearly half of its western shoreline. The two types of mud flats described are 1) exposed muddy tidal flats, such as are observed in association with the **wavecut** sandstone platforms in southern Kamishak Bay, and 2) protected estuarine flats, which are "primarily drowned glaciated river valleys (rias)" such as Chinitna Bay (Hayes et al. 1977). Because of the difference in exposure and probable residence time, exposed flats were considered to be moderately susceptible to oil pollution (rank of 5) and protected flats to be highly susceptible (rank of 9; Hayes et al. 1977). These investigators described the flats as impermeable to oil. In fact, we believe that permeability may vary **considerably**, depending on the **faunal** components. Where the flats are dominated by Macoma balthica, but *Mya* spp. and Echiurus are absent, the flats indeed appear impermeable. Mud Bay, at Homer, and **Dayville Flats**, at Valdez, are examples of this type of flat. Shaw et al. (1977), in fact, reported low uptake and rapid loss of crude oil on Dayville Flats. Griffiths (personal communication) suggests that **Shaw's** findings may have been influenced by low densities of bacteria and organic debris, which have a direct relationship to uptake rates. However, where *Mya* and Echiurus are common their burrows, with densities of up to 100/m² and extending up to 45 cm into the sediment, may increase the rate of oil penetration into the sediment, and allow oil to be stored at deep, anoxic levels. All mud flats observed to date on the west side of Cook Inlet are of this type.

Because of anoxic conditions near the sediment surface, and the low energy regime of the protected estuaries, residence time could extend up to 10 years in some of these areas (Hayes et al. 1977).

The fauna, dominated by **longevous** clam and **polychaete** species, includes several species that have been shown to be sensitive to oil contamination. For instance, Shaw et al. (1976) reported significant mortality in Macoma balthica in response to low dosages of Prudhoe Bay crude oil in elegant field experiments on **Dayville** Flats. Hampson and Sanders (1969) reported considerable mortality of M. arenaria and many **polychaete** species in West **Falmouth**, Mass. , after exposure to high doses of fuel oil. Feder et al. (1976) observed anomalous increases in the density of harpacticoid copepods on **Dayville** Flats, but the causes and ramifications are not clear.

Because it appears that most of the tissue produced on the mud flats is utilized by transient predators from other systems, the condition of the mud flats is of considerable concern and importance. Animals particularly reliant on continued high productivity of the mud flats include 1) smelts of at **least** two species of salmon in spring (**Sibert** et al. 1977), 2) Western Sandpipers on spring migration, and 3) ducks, especially **scoters**, scaup and **Oldsquaw**, all year long. Only ducks and gulls appear to depend on adult or long-lived animals.

Recovery rates following contamination are subject to several conditions. Obviously, local conditions (orientation of estuary, time of year, tidal phase, porosity of the flat) are of importance. If appreciable quantities of oil penetrate deeply into the sediment, however, it is probable that full recovery will require at least 10 years. The dominant clam species all live at least 6-10 years (Chambers and **Milne** 1975, Feder and Paul 1974). Ducks appear to feed mainly on adult Macoma. Shorebirds, in **contrast**, feed mainly on young-of-year Macoma, Mya, annual **polychaetes** and harpacticoid copepods, which could recover fairly quickly if the sediments were uncontaminated. Based

on the predictions of Hayes et al. (1977), it is probable that the exposed flats would recover in several years, but that the estuaries could require at least a decade.

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TAXA	1	2	3	4	5	6	7	8	9	10	$\bar{x} \pm s$	Total
Level 1 (Upper)												
ANNELIDA - Polychaeta												
<u>Capitella capitata</u>	0	0	0	0	1	0	1	0	0	0	0.2 ± 0.4	2
<u>Eteone nr. longa</u>	1	0	1	2	0	0	0	1	2	2	0.9 ± 0.9	9
ARTHROPODA - Gammaridae												
<u>Anisogammarus cf confervicolus</u>	0	0	0	0	1	0	0	0	0	0	0.1 ± 0.3	1
<u>Eohaustorius eous</u>	0	2	1	0	2	1	0	0	0	0	0.6 ± 0.8	6
s	1	1	2	1	3	1	1	1	1	1		
N	1	2	2	2	4	1	1	1	2	2		
Extralimital Species:	<u>Halichondria panicea</u> on Sabellid tube, <u>Mytilus edulis</u> on boulder											

Level 2

ANNELIDA - Polychaeta												
<u>Capitella capitata</u>	0	0	0	0	0	1	0	0	0	0	0.1 ± 0.3	1
<u>Eteone nr. longa</u>	0	0	0	0	1	0	1	1	0	0	0.3 ± 0.5	3
ARTHROPODA - Gammaridea												
<u>Eohaustorius eous</u>	3	1	2	1	0	0	1	2	6	1	1.7 ± 1.8	17
S	1	1	1	1	1	1	2	2	1	1		
N	3	1	2	1	1	1	2	3	6	1		

TAXA	1	2	3	4	5	6	7	8	9	10	$\bar{x} \pm s$	Total	
Level 3													
ANNELIDA - Polychaeta													
<u>Eteone</u> nr. <u>longs</u>	0	1	0	0	0	0	0	0	0	0	0.1	0.3	1
<u>Paraonella</u> <u>platybranchia</u>	0	0	0	0	0	0	1	1	2	0	0.4	0.7	4
<u>Scoelelepis</u> Sp. A	0	0	0	0	0	0	0	1	0	0	0.1	0.3	1
<u>Scoloplos</u> <u>armiger</u>	1	0	0	0	0	0	0	0	0	1	0.2	0.4	2
ARTHROPODA - Gammaridae													
<u>Eohaustorius</u> <u>eous</u>	1	4	2	5	5	1	6	2	1	3	3.0	1.9	30
<u>Paraphoxus</u> <u>milleri</u>	1	0	0	0	0	0	0	0	0	0	0.1	0.3	1
s	3	2	1	1	1	1	1	3	2	2			
N	3	5	2	5	5	2	7	4	3	4			
Level 4 (lower)													
ANNELIDA - Polychaeta													
<u>Eteone</u> nr. <u>longs</u>	0	0	1	0	0	0	0	0	0	0	0.1	0.3	1
<u>Paraonella</u> <u>platybranchia</u>	0	0	0	0	0	1	0	0	0	0	0.1	0.3	1
<u>Scoelelepis</u> Sp. A	0	1	0	0	1	0	1	0	1	0	0.4	0.5	4
ARTHROPODA - Gammaridea													
<u>Anisogammarus</u> cf <u>confervicolus</u>	0	0	0	0	0	0	0	1	0	0	0.1	0.3	1
<u>Eohaustorius</u> <u>eous</u>	4	5	10	16	11	6	9	1	6	6	7.4	4.2	74
<u>Paraphoxus</u> <u>milleri</u>	0	1	0	0	0	0	0	0	1	0	0.2	0.4	2
ARTHROPODA - mysidacea													
<u>Archaeomysis</u> <u>grebnitzkii</u>	0	0	0	1	0	0	0	0	0	0	0.1	0.3	1
s	1	3	2	2	2	2	2	2	3	1			
N	4	7	11	17	12	6	10	3	8	6			

APPENDIX Ib. ABUNDANCE DATA FOR CORE **SAMPLES** FROM DEEP CREEK BEACH;
7 APRIL 1977.

TAXA	1	2	3	4	5	6	7	8	9	10	$\bar{x} \pm s$	Total
Level 1 (Upper)												
ANNELIDA - Polychaeta												
<u>Eteone</u> nr. <u>longs</u>	1	0	1	0	0	0	0	0	1	0	0.3 ± 0.5	3
<u>Scoloplos</u> <u>armiger</u>	0	0	0	0	0	0	0	1	0	0	0.1 ± 0.3	1
ARTHROPODA - Gammaridea												
<u>Anisogammarus</u> cf <u>confervicolus</u>	0	1	0	0	0	0	0	0	0	0	0.1 ± 0.3	1
<u>Eohaustorius</u> <u>eous</u>	0	0	0	0	0	0	1	0	0	0	0.1 ± 0.3	1
<u>Paraphoxus</u> <u>milleri</u>	0	2	0	0	2	0	0	0	0	0	0.4 ± 0.8	4
s	1	2	1	0	1	0	1	1	1	0		
N	1	3	1	0	2	0	1	1	1	0		
Level 2												
ANNELIDA - Polychaeta												
<u>Capitella</u> <u>capitata</u>	0	1	0	0	0	0	0	0	0	0	0.1 ± 0.3	1
<u>Nephtys</u> ? <u>ciliata</u>	0	0	0	0	0	0	1	0	0	0	0.1 ± 0.3	1
<u>Paraonella</u> <u>platybranchia</u>	0	0	0	0	0	0	0	0	0	1	0.1 ± 0.3	1
ARTHROPODA - Gammaridea												
<u>Eohaustorius</u> <u>eous</u>	0	1	2	0	1	4	10	4	4	1	2.7 ± 3.0	27
<u>Paraphoxus</u> <u>milleri</u>	0	0	0	0	0	0	0	1	0	0	0.1 ± 0.3	1
s	0	2	1	0	1	1	2	2	1	2		
N	0	2	2	0	1	4	11	4	4	2		

TAXA	1	2	3	4	5	6	7	8	9	10	$\bar{x} \pm s$	Total
Level 3												
ANNELIDA - Polychaeta												
<u>Paraonella platybranchia</u>	0	0	0	1	0	0	0	1	0	0	0.2 ± 0.4	2
<u>Scoloplos armiger</u>	0	0	0	0	0	0	0	0	2	0	0.2 ± 0.6	2
<u>Scoelelepis</u> Sp. A	0	0	0	0	0	0	0	0	1	0	0.1 ± 0.3	1
ARTHROPODA - Gammaridea												
<u>Eohaustorius eous</u>	3	7	2	3	0	0	0	3	2	8	2.8 ± 2.8	28
? <u>Ischyroceridae</u> , unid.	0	0	0	0	1	0	0	0	0	0	0.1 ± 0.3	1
<u>Paraphoxus milleri</u>	1	0	0	0	0	0	0	0	0	0	0.1 ± 0.3	1
s	2	1	1	2	1	0	0	2	3	1		
N	4	7	2	4	1	0	0	4	5	8		
Level 4 (Lower)												
ANNELIDA - Polychaeta												
<u>Nephtys ?ciliata</u>	0	0	2	0	0	0	0	0	0	0	0.2 ± 0.6	2
<u>Scoloplos armiger</u>	0	1	1	0	0	0	0	0	0	0	0.2 ± 0.4	2
<u>Scoelelepis</u> Sp. A	1	1	1	1	0	0	0	2	2	1	0.9 ± 0.7	9
ARTHROPODA - Gammaridea												
<u>Anisogammarus</u> cf. <u>confervicolus</u>	0	0	0	1	0	0	0	0	0	0	0.1 ± 0.3	1
<u>Eohaustorius eous</u>	15	7	3	8	13	4	3	16	13	7	8.9 ± 5.0	89
Gammaridea, unid.	0	0	0	0	0	1	0	0	0	0	0.1 ± 0.3	1
Lysianassidae, unid.	0	0	1	0	0	0	0	0	0	0	0.1 ± 0.3	1
<u>Paraphoxus milleri</u>	0	1	0	1	0	0	0	0	0	1	0.3 ± 0.5	3
s	2	4	5	4	1	2	1	2	2	3		
N	16	10	8	11	13	5	3	18	15	9		

TAXA	1	2	3	4	5	6	7	8	9	10	$\bar{x} \pm s$	Total
Level 1 (Upper)												
ANNELIDA - Polychaeta												
<u>Eteone</u> nr. <u>longs</u>	0	0	0	0	0	0	0	1	0	0	0.1 ± 0.3	1
<u>Paraonella</u> <u>platybranchia</u>	1	0	0	0	0	0	0	0	0	0	0.1 ± 0.3	1
<u>Scoelelepis</u> Sp. A	1	1	0	1	0	1	0	0	0	1	0.5 ± 0.5	5
ARTHROPODA - Gammaridea												
<u>Eohaustorius</u> eous	2	7	0	4	1	3	1	4	2	4	2.8 ± 2.0	28
Gammaridae, Sp. A	1	0	1	1	1	0	0	0	0	0	0.4 ± 0.5	4
s	4	2	1	3	2	2	1	2	1	2	2.0 ± 0.9	
N	5	8	1	6	2	4	1	5	2	5	3.9 ± 2.3	
Level 2												
ANNELIDA - Polychaeta												
<u>Abarenicola</u> Sp.	0	0	1	0	0	0	1	0	0	0	0.2 ± 0.4	2
<u>Capitella</u> capitata	0	0	0	0	0	0	0	1	0	1	0.2 ± 0.4	2
<u>Eteone</u> nr. <u>longs</u>	0	0	0	2	0	0	0	0	0	0	0.2 ± 0.6	2
<u>Paraonella</u> <u>platybranchia</u>	0	0	1	0	0	0	0	0	0	0	0.1 ± 0.3	1
<u>Scoelelepis</u> Sp. A	1	0	1	1	2	1	1	2	1	1	1.1 ± 0.6	11
<u>Scoloplos</u> armiger	0	0	1*	1*	1	1	0	0	0	0	0.4 ± 0.5	4
ARTHROPODA - Gammaridea												
<u>Eohaustorius</u> eous	4	8	6	2	11	6	9	3	2	1	5.2 ± 3.4	52
Gammaridae Sp. A	46	0	0	0	1	0	30	14	0	3	9.4 ± 16.1	94

TAXA	1	2	3	4	5	6	7	8	9	10	$\bar{x} \pm s$	Total
Level 2 Cont.												
<u>Lamprops</u> <u>quadriplicata</u>	0	0	0	0	0	0	1	0	1	0	0.2 ± 0.4	2
<u>Oedocerotidae</u> Sp.	0	0	0	0	1	0	0	0	0	0	0.1 ± 0.3	1
<u>Paraphoxus milleri</u>	0	0	0	0	0	1	0	0	0	0	0.1 ± 0.3	1
<u>Synchelidium</u> Sp.	0	0	0	0	1	0	0	0	0	0	0.1 ± 0.3	1
ARTHROPODA - Mysidacea												
<u>Archaeomysis</u> <u>grebnitzkii</u>	0	0	0	0	1	0	0	0	0	0	0.1 ± 0.3	1
s	3	1	5	4	6	4	5	4	3	4	3.9 ± 1.4	
N	51	8	10	6	17	9	42	20	4	6	17.3 ± 16.3	
Level 3												
ANNELIDA - Polychaeta												
<u>Chaetozone setosa</u>	0	0	0	0	0	1	0	0	0	0	0.1 ± 0.3	1
<u>Nephtys ?ciliata</u>	0	0	0	0	0	0	1*	0	0	0	0.1 ± 0.3	1
<u>Paraonella</u> <u>platybranchia</u>	0	1*	0	0	0	0	0	0	0	0	0.1 ± 0.3	1
<u>Scoelelepis</u> Sp. A	0	0	0	1	0	1	0	2	0	0	0.4 ± 0.7	4
<u>Scoloplos armiger</u>	1	1*	0	0	0	0	1*	1	1*	0	0.5 ± 0.5	5
ARTHROPODA - Gammaridea												
<u>Atylidae</u> Sp. A	0	0	0	1	0	0	0	0	0	0	0.1 ± 0.3	1
<u>Eohaustorius</u> eous	12	9	2	6	15	6	5	7	4	4	7.0 ± 4.0	70
<u>Gammaridae</u> Sp. A	3	0	1	2	0	2	3	0	0	0	1.1 ± 1.3	11
<u>Lamprops</u> <u>quadriplicata</u>	1	0	0	1	1	0	0	0	1	0	0.4 ± 0.5	4
<u>Paraphoxus milleri</u>	1	0	0	0	0	0	0	1	0	0	0.2 ± 0.4	2
<u>Synchelidium</u> Sp.	0	0	0	0	1	0	0	0	0	0	0.1 ± 0.3	
s	5	3	2	5	3	4	4	4	3	1	3.4 ± 1.3	
N	18	11	3	11	17	10	10	11	6	4	10.1 ± 4.9	

TAXA	1	2	3	4	5	6	7	8	9	10	$\bar{x} \pm s$	Total
Level 4 (Lower)												
ANNELIDA - Polychaeta												
<u>Capitella capitata</u>	0	0	0	0	0	0	1	0	0	0	0.1 ± 0.3	1
<u>Nephtys ?ciliata</u>	0	1*	0	0	1	0	0	0	0	0	0.2 ± 0.4	2
<u>Paraonella platybranchia</u>	0	0	0	0	0	0	0	0	0	1	0.1 ± 0.3	1
<u>Scoelelepis</u> Sp. A	0	0	0	1	2	2	2	0	0	2	0.9 ± 1.0	9
<u>Scoloplos armiger</u>	0	0	0	0	0	0	1	0	0	0	0.1 ± 0.3	1
ARTHROPODA - Gammaridea												
<u>Eohaustorius eous</u>	3	7	9	6	1	0	19	2	2	4	5.3 ± 5.6	53
Gammaridae Sp. A	1	0	0	0	2	3	0	2	0	5	1.3 ± 1.7	13
<u>Paraphoxus milleri</u>	1	0	0	2	0	0	0	0	0	0	0.3 ± 0.7	3
s	3	2	1	3	4	2	4	2	1	4	3.3 ± 2.4	
N	5	8	9	9	6	5	23	4	2	12	7.8 ± 6.4	

* Fragment

TAXA	Station No.:	Density (No./m ²)			
		1	2	3	4*
ANNELIDA - Polychaeta					
<u>Capitella capitata</u>		25.5	12.7	0	0
<u>Eteone</u> nr. <u>longa</u>		114.6	38.2	12.7	12.7
<u>Paraonella platybranchia</u>		0	0	50.9	12.7
<u>Scolelepis</u> Sp. A		0	0	12.7	50.9
<u>Scoloplos armiger</u>		0	0	25.5	0
ARTHROPODA - Gammaridea					
<u>Anisogammarus</u> cf. <u>confervicolus</u>		12.7	0	0	12.7
<u>Eohaustorius eous</u>		76.4	216.4	381.9	942.2
<u>Paraphoxus milleri</u>		0	0	12.7	25.5
ARTHROPODA - Mysidacea					
<u>Archaeomysis grebnitzkii</u>		0	0	0	12.7
Total Number of Specimens:		18	21	39	84

* Lowest level on beach

APPENDIX IIb. DENSITY OF ORGANISMS IN **INFAUNAL** SAMPLES BY
LEVEL AT **DEEP CREEK**, 7 APRIL 1977

<u>TAXA</u>	<u>Station No.:</u>	<u>Density (No./m²)</u>			
		<u>1</u>	<u>2</u>	<u>3</u>	<u>4*</u>
ANNELIDA - Polychaeta					
<u>Capitella capitata</u>		0	12.7	0	0
<u>Eteone</u> nr. <u>longa</u>	38.2		0	0	0
<u>Nephtys ?ciliata</u>		0	12.7	0	25.5
<u>Paraonella platybranchia</u>		0	12.7	25.5	0
? <u>Scolelepis</u> Sp. A		0	0	12.7	114.6
<u>Scoloplos armiger</u>		12.7	0	25.5	25.5
ARTHROPODA - Gammaridea					
<u>Anisogammarus</u> cf. <u>confervicolus</u>		12.7	0	0	12.7
<u>Eohaustorius</u> Sp.		12.7	343.7	356.4	1133.0
Gammaridea, unid.		0	0	12.7	25.5
<u>Paraphoxus</u> Sp.		50.9	12.7	12.7	38.2
Total Number of Specimens:		10	31	35	108

* Lowest level on beach

TAXA	Station No.:	Density (No./m ²)			
		1	2	3	4*
ANNELIDA - Polychaeta					
<u>Abarenicola</u> Sp.		0	25.5	0	0
<u>Capitella capitata</u>		0	25.5	0	12.7
<u>Chaetozone setosa</u>		0	0	12.7	0
<u>Eteone</u> nr. <u>longs</u>		12.7	25.5	0	0
<u>Nephtys ?ciliata</u>		0	0	12.7	25.5
<u>Paraonella platybranchia</u>		12.7	12.7	12.7	12.7
<u>Scolelepis</u> Sp. A		63.7	140.1	50.9	114.6
<u>Scoloplos armiger</u>		0	50.9	63.7	12.7
ARTHROPODA - Gammaridea					
Atylidae Sp. A		0	0	12.7	0
<u>Eohaustorius eous</u>		356.6	662.1	891.3	674.8
Gammaridae Sp. A		50.9	1196.8	140.1	165.5
<u>Lamprops quadriplicata</u>		0	25.5	50.9	0
<u>Paraphoxus milleri</u>		0	12.7	25.5	38.2
<u>Synchelidium</u> Sp.		0	12.7	12.7	0
ARTHROPODA - Mysidacea					
<u>Archaeomysis grebnitzkii</u>		0	12.7	0	0
Total Number of Specimens:		39	173	101	83

* Lowest level on beach

APPENDIX IIIa.

POOLED SIZE DATA FOR EOHAUSTORIUS EOUS
AT DEEP CREEK IN 1977

Size Class (mm)	<u>4/7/77</u>	<u>7/29/77</u>
1.3 - 1.5		1
1.6 - 1.8		1
1.9 - 2.1	2	6
2.2 - 2.4	12	8
2.5 - 2.7	13	16
2.8 - 3.0	7	19
3.1 - 3.3	7	10
3.4 - 3.6	8	17
3.7 - 3.9	9	21
4.0 - 4.2	19	31
4.3 - 4.5	15	33
4.6 - 4.8	26	14
4.9 - 5.1	12	12
5.2 - 5.4	7	4
5.5 - 5.7	3	2
5.8 - 6.0	1	
Mean length (mm)	3.9	3.8
s	1.0	0.9

APPENDIX IIIb.

LENGTH DATA FOR UNID. GAMMARIDAE WITH DARK
EYE AND COARSE ANTENNAE, DEEP CREEK, 29 JULY 77

	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>Total</u>
1.5		3			3
1.6		2			2
1.7		1	1	1	3
1.8		2			2
1.9	1	3			4
2.0	1	3		3	7
2.1		3			3
2.2		9	3	2	14
2.3		8	1	1	10
2.4		1	1	2	4
2.5	1	8	2	1	12
2.6		2	1		3
2.7		5		1	6
2.8		7			7
2.9		4			4
3.0		1		1	2
3.1		1			1
3.2		3		1	4
3.3		3			3
3.4		3			3
3.5		1	1		2
3.6		1			1
3.7		2			2
7.0		1			1

n = 103

 \bar{x} = 2.52

s = 0.69

TAXA	1	2	3	4	5	$\bar{x} \pm s$	Total
Cores* near 30m level							
ANNELIDA - Polychaeta							
<u>Eteone</u> nr. <u>longs</u>	0	0	0	0	1	0.2 ± 0.4	1
<u>Paraonella</u> <u>platybranchia</u>	2	1	0	0	1	() .8 ± 0.8	4
<u>Scoelepis</u> Sp. A	1	1	1	1	2	1.2 ± 0.4	6
ARTHROPODA - Mysidacea							
<u>Archaeomysis</u> <u>grebnitzkii</u>	0	0	0	0	1	0.2 ± 0.4	1
Total	3	2	1	1	5		
Cores* near 75m level							
ANNELIDA - Polychaeta							
<u>Nephtys</u> ? <u>ciliata</u>	0	1	0	0	0	0.2 ± 0.4	1
<u>Scoelepis</u> Sp. A	1	0	0	2	0	0.6 ± 0.9	3
<u>Spionidae</u> , unid.	0	1	0	0	0	0.2 ± 0.4	1
<u>Typosyllis</u> Sp.	0	1	0	0	0	0.2 ± 0.4	1
ARTHROPODA - Gammaridea							
<u>Eohaustorius</u> <u>eous</u>	0	1	0	0	1	0.4 ± 0.5	2
Total	1	4	0	2	1		

TAXA	1	2	3	4	5	$\bar{x} \pm s$	Total
Cores* from 100m level							
ANNELIDA - Polychaeta							
<u>Magelona pitelkai</u>	0	1	0	0	0	0.2 ± 0.4	1
<u>Paraonella platybranchia</u>	1	4	3	0	4	2.4 ± 1.8	12
<u>Scoelelepis</u> Sp. A	1	2	1	5	2	2.2 ± 1.6	11
ARTHROPODA - Gammaridea							
<u>Eohaustorius eous</u>	0	0	1	0	0	0.2 ± ().4	1
Gammaridae, unid. (red-striped)	0	0	1	0	1	0.4 ± 0.5	2
<u>Paraphoxus milleri</u>	1	0	1	1	1	0.8 ± 0.4	4
PISCES							
<u>Ammodytes hexapterus</u>	0	0	1	1	0	0.4 ± 0.5	2
Total	3	7	8	7	8		
Cores* from 132m level							
ANNELIDA - Polychaeta							
<u>Magelona pitelkai</u>	0	0	0	1	0	0.2 * 0.4	1
<u>Paraonella platybranchia</u>	0	0	2	2	3	1.4 ± 1.3	7
<u>Scoelelepis</u> Sp. A	8	2	5	6	2	4.6 ± 2.6	23
ARTHROPODA - Gammaridea							
Gammaridae, unid. (red-striped)	0	2	2	0	0	0.8 ± 1.1	4
<u>Paraphoxus milleri</u>	0	0	0	1	2	0.6 ± 0.9	3
MOLLUSCA - Gastropod							
<u>Littorina sitkana</u>	0	0	2	0	0	13.4 ± 00,	2
MOLLUSCA - Pelecypoda							
<u>Spisula polynyma</u>	0	0	0	2	0	0.4 ± 0.9	2
Total	8	4	11	12	7		

TAXA	1	2	3	4	5	6	7	8	9	10	$\bar{x} \pm s$	Total
Cores* from 30m level												
ANNELIDA - Polychaeta												
<u>Nephtys ?ciliata</u>	0	0	0	0	0	0	1	0	0	0	0.1 ± 0.3	1
<u>Scoelelepis</u> Sp. A	0	0	0	1	2	0	0	3	1	0	0.7 ± 1.1	7
ARTHROPODA - Gammaridea												
<u>Paraphoxus milleri</u>	0	0	0	1	0	0	0	0	0	0	0.1 ± 0.3	1
Total	0	0	0	2	2	0	1	3	1	0		
Cores* from 75m level												
ANNELIDA - Polychaeta												
<u>Nephtys ?ciliata</u>	0	0	0	0	0	0	1	0	0	0	0.1 ± 0.3	1
<u>Paraonella platybranchia</u>	0	0	0	0	0	0	1	1	0	2	0.4 ± 0.7	4
<u>Scoelelepis</u> Sp. A	0	1	1	0	1	4	1	3	2	0	1.3 ± 1.3	13
ARTHROPODA - Gammaridea												
<u>Anonyx</u> Sp.	0	0	0	0	0	0	0	0	0	1	0.1 ± 0.3	1
<u>Eohaustorius eous</u>	1	0	0	0	0	0	0	0	0	0	0.1 ± 0.3	1
<u>Paraphoxus milleri</u>	1	0	0	0	1	1	0	0	2	0	0.5 ± 0.7	5
Total	2	1	1	0	2	5	3	4	4	3		

TAXA	1	2	3	4	5	6	7	8	9	10	$\bar{x} \pm s$	Total
Cores* from 100m level												
ANNELIDA - Polychaeta												
<u>Nephtys ?ciliata</u>	0	0	0	0	0	0	0	0	1	0	0.1 ± 0.3	1
<u>Paraonella platybranchia</u>	0	1	0	2	1	1	2	0	1	0	0.8 ± 0.8	8
Sabellidae, unid.	0	0	1	0	0	0	0	0	0	0	0.1 ± 0.3	1
<u>Scoelelepis</u> Sp. A	2	1	1	4	4	1	5	0	7	5	3.0 ± 2.3	30
<u>Scoloplos armiger</u>	0	0	0	0	0	0	2	0	0	0	0.2 ± 0.6	2
ARTHROPODA - Gammaridea												
<u>Eohaustorius eous</u>	0	0	0	1	1	0	0	0	0	0	0.2 ± 0.4	2
<u>Paraphoxus milleri</u>	1	0	2	0	0	0	0	0	0	0	0.3 ± 0.7	3
MOLLUSCA - Pelecypoda												
<u>Mytilus edulis</u> (juv.)	0	0	1	0	0	0	0	0	0	0	0.1 ± 0.3	1
Total	3	2	5	7	6	2	9	0	9	5		
Cores* from 135m level												
ANNELIDA - Polychaeta												
<u>Magelona pitelkai</u>	1	0	0	0	0	0	0	0	0	0	0.1 ± 0.3	1
<u>Scoelelepis</u> Sp. A	19	1	6	16	4	12	3	5	1	4	7.1 ± 6.3	71
ARTHROPODA - Gammaridea												
<u>Eohaustorius eous</u>	0	1	0	0	0	0	0	0	0	0	0.1 ± 0.3	1
<u>Paraphoxus milleri</u>	1	0	1	0	1	0	0	1	0	3	0.7 ± 0.9	7
MOLLUSCA - Pelecypoda												
<u>Spisula polynema</u> (juv.)	0	0	0	0	0	0	1	0	0	0	0.1 ± 0.3	1
CHORDATA - Pisces												
<u>Ammodytes hexapterus</u>	0	0	0	0	0	0	1	1	0	0	0.2 ± 0.4	2
Total	21	2	7	16	5	12	5	7	1	7		

TAXA	1	2	3	4	5	6	7	8	9	10	$\bar{x} \pm s$	Total
Cores* from 30m level												
PLATYHELMINTHES												
<u>Turbellaria</u> , unid.	0	0	0	1	0	0	0	0	0	0	0.1 ± 0.3	1
ANNELIDA - Polychaeta												
<u>Nephtys</u> Sp. (juv.)	0	0	0	1	1	1	0	1	0	0	0.4 ± 0.5	4
<u>Paraonella</u> <u>platybranchia</u>	0	0	0	3	3	4	5	0	0	0	1.5 ± 2.0	15
<u>Scoelelepis</u> Sp. A	0	0	2	0	2	4	1	1	4	1	1.5 ± 1.5	15
<u>Spiophanes</u> ? <u>bombyx</u>	0	0	0	0	1	0	0	0	0	0	0.1 ± 0.3	1
ARTHROPODA - Crustacea												
<u>Crangon</u> ? <u>alaskensis</u> <u>elongata</u> (juv.)	0	0	0	0	0	0	0	1	0	0	0.1 ± 0.3	1
<u>Lamprops</u> <u>carinata</u>	0	0	0	0	1	1	0	2	1	0	0.5 ± 0.7	5
L. <u>quadriplata</u>	0	0	0	0	6	2	2	5	1	0	1.6 ± 2.2	16
<u>Eohaustorius</u> <u>eous</u>	0	0	1	0	1	0	0	0	0	0	0.2 ± 0.4	2
Gammaridae, unid.	0	0	1	0	0	0	0	0	0	0	0.1 ± 0.3	1
<u>Paraphoxus</u> <u>milleri</u>	0	1	0	0	0	0	0	0	1	0	0.2 ± 0.4	2
MOLLUSCA - Pelecypoda												
<u>Protothaca</u> <u>staminea</u>	0	0	0	0	0	0	0	0	1	0	0.1 ± 0.3	1
Total	0	1	4	5	15	12	8	10	8	1		

TAXA	1	2	3	4	5	6	7	8	9	10	$\bar{x} \pm s$	Total
Cores* from 75m level												
ANNELIDA - polychaeta												
<u>Capitella capitata</u>	0	0	0	0	0	0	1	4	0	0	0.5 ± 1.3	5
<u>Nephtys ?ciliata</u>	1	0	0	0	0	1	0	0	0	0	0.1 ± 0.3	1
<u>Nephtys</u> Sp. (juv.)	1	0	0	0	0	0	0	0	0	0	0.1 ± 0.3	1
<u>Paraonella platybranchia</u>	2	4	2	1	3	1	0	0	0	0	1.3 ± 1.4	13
<u>Scolelepis</u> Sp. A	1	4	1	2	0	3	1	0	1	2	1.5 ± 1.3	15
ARTHROPODA - Crustacea												
<u>Crangon ?alaskensis elongata</u> (juv.)	0	0	0	0	1	0	0	0	1	0	0.2 ± 0.4	2
<u>Eohaustorius eous</u>	0	0	0	0	0	0	0	1	0	0	0.1 ± 0.3	1
<u>Lamprops carinata</u>	1	0	0	1	0	0	0	0	0	0	0.2 ± 0.4	2
L. <u>quadriplicata</u>	0	0	0	0	2	1	1	0	0	0	0.4 ± 0.7	4
<u>Lamprops</u> Sp.	0	1	0	0	0	0	0	0	0	0	0.1 ± 0.3	1
<u>Synchelidium</u> Sp.	0	0	0	1	0	0	0	0	0	0	0.1 ± 0.3	1
Total	6	9	3	5	6	6	3	5	2	2		
Cores* from 100m level												
ANNELIDA - Polychaeta												
<u>Capitella capitata</u>	0	0	1	0	0	0	0	0	0	0	0.1 ± 0.3	1
<u>Nephtys</u> Sp. (juv.)	0	0	1	0	0	0	0	0	0	0	0.1 ± 0.3	1
<u>Paraonella platybranchia</u>	3	4	3	4	0	4	3	1	1	6	2.9 ± 1.8	29
<u>Scolelepis</u> Sp. A	6	2	2	3	3	2	3	1	5	7	3.4 ± 2.0	34

TAXA	1	2	3	4	5	6	7	8	9	10	$\bar{x} \pm s$	Total
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Cores* from 100m level Cont.

ARTHROPODA - Crustacea

<u>Eohaustorius eous</u>	1	0	0	1	0	0	1		1	0	0	0.4 ± 0.5	4
<u>Lamprops carinata</u>	0	0	0	0	0	0	1		0	0	0	0.1 ± 0.3	1
<u>Paraphoxus milleri</u>	0	0	0	0	0	1	0		0	0	1	0.2 ± 0.4	2
<u>Synchelidium</u> Sp.	0	0	0	0	2	0	0		0	0	0	0.2 ± 0.6	2

PISCES

<u>Ammodytes hexapteru s</u>	0	0	0	0	1	0	0	0	0	0		0.1 ± 0.3	1
Total	10	6	7	8	6	7	8	3	6	14			

Cores* from 135m level

ANNELIDA - Polychaeta

<u>Capitella capitata</u>	0	2	0	0	0	0	0	0	0	0		0.2 ± 0.6	2
<u>Eteone nr. longs</u>	0	0	0	0	0	0	0	0	0	1		0.1 ± 0.3	1
<u>Paraonella platybranchia</u>	0	1	0	2	2	0	4	1	0	0		1.0 ± 1.3	10
<u>Scolèlepis</u> Sp. A	14	3	8	9	12	7	11	16	8	20		10.8 ± 4.9	108

ARTHROPODA - Crustacea

<u>Crangon ?alaskensis elongata</u>	0	0	0	0	0	0	0	0	0	1		0.1 ± 0.3	1
<u>Eohaustorius eous</u>	0	0	0	0	0	0	0	0	1	1		0.2 ± 0.4	2
<u>Lamprops carinata</u>	1	1	0	0	0	1	2	0	4	2		1.1 ± 1.3	11
<u>L. quadriplicata</u>	0	2	0	0	0	0	1	1	1	0		0.5 ± 0.7	5
<u>Paraphoxus milleri</u>	0	0	0	1	0	1	0	0	0	0		0.2 ± 0.4	2

MOLLUSCA - Pelecypoda

<u>Spisula polynyma</u>	0	0	0	0	0	0	0	0	2	0		0.2 ± 0.6	2
Total	15	9	8	12	14	9	18	18	16	25			

<u>TAXA</u>	Density (hTo./m ²)			
	<u>30m</u>	<u>75 m</u>	<u>100m</u>	<u>132m*</u>
ANNELIDA - Polychaeta				
<u>Eteone</u> nr. <u>longs</u>	25.5	0	0	0
<u>Magelona</u> <u>pitelkai</u>	0	0	25.5	25.5
<u>Nephtys</u> ? <u>ciliata</u>	0	25.5	0	0
<u>Paraonella</u> <u>platybranchia</u>	101.9	0	305.6	178.3
<u>Scolelepis</u> Sp. A	152.8	76.4	280.1	585.7
Spionidae, unid.	0	25.5	0	0
<u>Typosyllis</u> Sp.	0	25.5	0	0
ARTHROPODA - Gammaridae				
<u>Eohaustorius</u> <u>eous</u>	0	50.9	25.5	0
Gammaridae, unid. (red-striped)	0	0	50.9	101.8
<u>Paraphoxus</u> <u>milleri</u>	0	0	101.8	76.4
ARTHROPODA - Mysidacea				
<u>Archaeomysis</u> <u>grebnitzkii</u>	25.5	0	0	0
MOLLUSCA - Gastropoda				
<u>Littorina</u> <u>sitkana</u>	0	0	0	50.9
MOLLUSCA - Pelecypoda				
<u>Spisula</u> <u>polynyma</u>	0	0	0	50.9
PISCES				
<u>Ammodytes</u> <u>hexapterus</u>	0	0	50.9	0

* lowest level on beach

<u>TAXA</u>	Density (No.m ²)			
	<u>30m</u>	<u>75m</u>	<u>100m</u>	<u>135m*</u>
ANNELIDA - Polychaeta				
<u>Magelona pitelkai</u>	0	0	0	12.7
<u>Nephtys ?ciliata</u>	12.7	12.7	12.7	0
<u>Paraonella platybranchia</u>	0	50.9	101.9	0
?Sabellidae, unid.	0	0	12.7	0
<u>Scolelepis</u> Sp. A	89.1	165.5	382.0	904.0
<u>Scoloplos armiger</u>	0	0	25.5	0
ARTHROPODA - Gammaridea				
<u>Anonyx</u> Sp.	0	12.7	0	0
<u>Eohaustorius eous</u>	0	12.7	25.5	12.7
<u>Paraphoxus milleri</u>	12.7	63.7	38.2	89.1
MOLLUSCA - Pelecypoda				
<u>Mytilus edulis</u> (juv.)	0	0	12.7	0
<u>Spisula polynyma</u>	0	0	0	12.7
PISCES				
<u>Ammodytes hexapterus</u>	0	0	0	25.5

*

lowest level on beach

<u>TAXA</u>	Density (No./m ²)			
	<u>30m</u>	<u>75m</u>	<u>100m</u>	<u>135m*</u>
PLATYHELMINTHES				
<u>Turbellaria</u> , unid.	12.7	0	0	0
ANNELIDA - Polychaeta				
<u>Capitella capitata</u>	0	63.7	12.7	25.5
<u>Eteone</u> nr. <u>longs</u>	0	0	0	12.7
<u>Nephtys</u> ? <u>ciliata</u>	0	12.7	0	0
<u>Nephtys</u> Sp. (juv.)	50.9	12.7	12.7	0
<u>Paraonella</u> <u>platybranchia</u>	191.0	165.5	369.2	127.3
<u>Scolelepis</u> Sp. A	191.0	191.0	432.9	1375.1
<u>Spiophanes</u> ? <u>bombyx</u>	12.7	0	0	0
ARTHROPODA - Crustacea				
<u>Crangon</u> ? <u>alaskensis</u> <u>elongata</u>	12.7	25.5	0	12.7
<u>Eohaustorius</u> <u>eous</u>	25.5	12.7	50.9	25.5
<u>Lamprops</u> <u>carinata</u>	63.7	25.5	12.7	140.1
L. <u>quadriplacata</u>	203.7	50.9	0	63.7
<u>Lamprops</u> Sp.	0	12.7	0	0
<u>Paraphoxus</u> <u>milleri</u>	25.5	0	25.5	25.5
<u>Synchelidium</u> Sp.	12.7	12.7	25.5	0

<u>TAXA</u>	Density (No./m ²)			
	<u>3 0m</u>	<u>75m</u>	<u>100m</u>	<u>135m*</u>
MOLLUSCA - <u>Pelecypoda</u>				
<u>Protothaca</u> <u>staminea</u>	12.7	0	0	0
<u>Spisula</u> <u>polynyma</u>	0	0	0	25.5
PISCES				
<u>Ammodytes</u> <u>hexapterus</u>	0	0	12.7	0

* lowest level on beach

TAXA	Number Per Core Sample										Estimated	
											$\bar{x} \pm s$	no./m ²
ECHIURIDAE												
<u>Echiurus echiurus</u>	0	1	0	0	0	0	0	0	0	0	0.1 ± 0.3	12.7
ANNELIDA - Polychaeta												
<u>Abarenicola pacifica</u>	0	0	0	0	0	0	0	0	0	1	0.1 ± 0.3	12.7
<u>Capitella capitata</u>	0	0	0	0	1	0	0	0	0	0	0.1 ± 0.3	12.7
<u>Eteone</u> nr <u>longs</u>	0	0	1	0	0	0	0	0	2	0	0.3 ± 0.7	38.2
<u>Glycinde polygnatha</u>	0	0	0	0	1	0	0	0	0	1	0.2 ± 0.4	25.5
<u>Harmothoe imbricata</u>	0	0	0	0	0	0	0	0	0	1	0.1 ± 0.3	12.7
<u>Malacoceros</u> sp	0	0	0	0	2	0	0	0	0	0	0.2 ± 0.6	25.5
<u>Nephtys</u> sp	1	0	2	0	0	0	1	1	0	0	0.5 ± 0.7	63.7
<u>Nephtys</u> sp (juv.)	0	1	1	0	3	1	1	0	0	0	0.7 ± 0.9	89.1
Paraonidae, unid.	1	0	0	0	0	0	0	0	0	0	0.1 ± 0.3	12.7
<u>Phyllodoce</u> <u>groenlandica</u>	0	0	0	0	2	0	0	0	0	0	0.2 ± 0.6	25.5
<u>Potamilla</u> sp	0	1	4	0	0	0	0	0	0	0	0.5 ± 1.3	63.7
MOLLUSCA - Pelecypoda												
<u>Clinocardium</u> <u>nuttallii</u> (juv.)	0	1	0	1	2	0	0	0	0	1	0.5 ± 0.7	63.7
<u>Macoma balthica</u>	25	31	26	46	45	32	41	22	32	65	36.5 ± 13.0	4647.3
<u>Mya arenaria</u>	0	0	0	0	2	1	1	2	0	1	0.7 ± 0.8	89.1
<u>Mya</u> Sp	0	0	0	0	0	0	1	0	0	0	0.1 ± 0.3	12.7
<u>Mya</u> spp (juv.)	0	0	0	1	8	0	2	0	0	1	1.2 ± 2.5	152.8
<u>Pseudopythina</u> sp	0	1	1	0	1	0	0	0	0	4	0.7 ± 1.3	89.1
No. of Individuals	27	36	35	48	67	34	47	25	34	75		
No. of Species	3	6	5	3	10	3	4	3	2	8		

ABUNDANCE DATA FOR CORE SAMPLES FROM THE +2.5 FOOT LEVEL AT
GLACIER SPIT, CHINITNA BAY INTERTIDAL AREA; 6 APRIL 1977

TAXA	Number Per Core Sample										x ± s	Estimated no./m ²
ECHIURIDAE												
<u>Echiurus echiurus</u>	1	0	1	1	0	1	1	1	2	0	0.8 ± 0.6	101.9
ANNELIDA - Polychaeta												
<u>Aphroditoididae</u>	1	0	0	0	0	0	1	0	0	1	0.3 ± 0.5	38.2
<u>Capitella capitata</u>	0	2	0	0	0	0	0	0	0	0	0.2 ± 0.4	25.5
<u>Eteone nr longis</u>	0	1	0	0	1	1	0	1	0	0	0.4 ± 0.5	50.9
<u>Glycinde polygnatha</u>	0	0	1	1	0	0	0	1	0	0	0.3 ± 0.5	38.2
<u>Harmothoe imbricata</u>	0	0	0	0	0	1	0	0	0	0	0.1 ± 0.3	12.7
<u>Nephtys sp</u>	2	1	1	0	0	1	0	0	1	1	0.7 ± 0.7	89.1
<u>Nephtys sp (juv.)</u>	2	2	2	0	0	0	2	1	1	1	1.1 ± 0.9	140.1
<u>Polydora caulleryi</u>	0	0	0	0	1	0	0	0	1	0	0.2 ± 0.4	25.5
<u>Potamilla sp</u>	0	2	1	1	0	0	1	0	0	1	0.6 ± 0.7	76.4
ARTHROPODA - Isopoda												
<u>Saduria entomon</u>	0	0	0	0	0	0	0	1	0	0	0.1 ± 0.3	12.7
MOLLUSCA - Pelecypoda												
<u>Clinocardium nuttallii (juv.)</u>	0	1	1	0	0	0	1	0	1	0	0.4 ± 0.5	50.9
<u>Macoma balthica</u>	40	33	29	32	35	35	32	53	22	38	34.9 ± 8.1	4443.6
<u>Mya arenaria</u>	0	1	0	1	0	0	0	1	1	1	0.5 ± 0.5	63.6
<u>M. priapus</u>	0	0	0	0	0	1	0	0	1	0	0.2 ± 0.4	25.5
<u>Mya sp fragment</u>	0	0	0	0	0	0	0	0	0	1	0.1 ± 0.3	12.7
<u>Mya spp (juv.)</u>	1	3	0	0	3	0	0	2	0	1	1.0 ± 1.2	127.3
<u>Pseudopythina sp</u>	0	6	4	2	0	0	0	1	3	0	1.6 ± 2.1	203.7
No. of Individuals	47	52	40	38	40	40	38	62	33	45		
No. of Species	5	9	7	6	4	6	6	9	8	6		

ABUNDANCE DATA FOR CORE SAMPLES FROM THE +0.9 FOOT LEVEL AT
GLACIER SPIT, CHINITNA BAY INTERTIDAL AREA; 6 APRIL 1977

TAXA	Number Per Core Sample										Estimated	
											$x \pm s$	no./m ²
ECHIURIDAE												
<u>Echiurus echiurus</u>	0	0	0	0	0	0	0	0	1	0	0.1 ± 0.3	12.7
ANNELIDA - Polychaeta												
<u>Ampharete acutifrons</u>	1	0	0	0	0	0	0	0	0	1	$0.2 \pm () .4$	25.5
<u>Capitella capitata</u>	1	0	1	0	0	0	0	0	0	0	0.2 ± 0.4	25.5
<u>Eteone nr longs</u>	0	0	0	1	0	1	0	0	1	0	0.3 ± 0.5	38.2
<u>Harmothoe imbricata</u>	0	0	0	0	0	0	0	0	1	0	$0.1 \pm 13,3$	12.7
<u>Malococeros</u> sp	0	0	0	0	0	0	0	0	0	1	0.1 ± 0.3	12.7
<u>Nephtys</u> sp	1	0	1	1	2	2	3	1	1	1	1.3 ± 0.8	165.5
<u>Nephtys</u> sp (juv.)	2	3	3	6	0	2	2	3	3	5	$2,9 \pm 1.7$	211.7
<u>Phyllodoce groenlandica</u>	0	0	1	0	0	0	0	0	0	1	$0.2 \pm () ,4$	25.5
<u>Polydora caulleryi</u>	0	0	0	0	0	0	2	0	0	0	0.2 ± 0.6	25.5
<u>Potamilla</u> sp	1	2	2	6	2	1	6	2	2	1	2.5 ± 1.9	318.3
MOLLUSCA - Pelecypoda												
<u>Clinocardium nuttallii</u> (juv.)	1	3	3	3	8	3	4	3	4	2	3.4 ± 1.8	432.9
<u>Macoma balthica</u>	37	37	38	37	50	38	57	29	64	33	42.0 ± 11.2	5347.6
<u>Mya priapus</u>	0	0	0	0	0	1	0	0	0	0	0.1 ± 0.3	12.7
<u>Mya</u> sp	1	0	1	0	0	0	0	0	0	0	0.2 ± 0.4	25.5
<u>Mya</u> spp (juv.)	1	1	4	9	13	7	13	6	13	21	8.8 ± 6.3	1120.5
<u>Pseudopythina</u> sp	0	1	0	0	0	0	6	1	4	6	1.8 ± 2.5	229.2
No. of Individuals	46	47	54	63	75	54	93	45	94	72		
No. of Species	8	6	7	6	5	7	7	6	9	9		

ABUNDANCE DATA FOR CORE SAMPLES FROM THE -1.2 FOOT LEVEL AT
GLACIER SPIT, CHINITNA BAY INTERTIDAL AREA; 6 APRIL 1977

TAXA	Number Per Core Sample										Estimated		
											x ± s	no./m ²	
ECHIURIDAE													
<u>Echiurus echiurus</u>	1	0	0	0	0	0	0	0	0	1	0	0.2 ± 0.4	25.5
ANNELIDA - Polychaeta													
<u>Ampharete acutifrons</u>	0	0	1	0	0	0	0	0	0	0	1	0.2 ± 0.4	25.5
<u>Capitella capitata</u>	1	0	0	0	0	0	0	0	0	0	0	0.1 ± 0.3	12.7
<u>Eteone nr longs</u>	0	1	0	0	0	1	0	0	0	0	0	0.2 ± 0.4	25.5
<u>Glycinde polygnatha</u>	0	0	0	0	0	1	1	0	1	0	0	0.3 ± 0.5	38.2
<u>Malacoceros</u> sp	0	0	0	0	0	0	0	0	0	1	0	0.1 ± 0.3	12.7
<u>Nephtys</u> sp	3	1	1	1	1	0	2	0	0	0	0	1.0 ± 1.0	127.3
<u>Nephtys</u> sp (juv.)	5	1	0	0	5	4	3	0	0	1	0	2.1 ± 2.1	267.4
<u>Phyllodoce groenlandica</u>	1	0	0	0	0	0	0	0	0	0	0	0.1 ± 0.3	12.7
<u>Polydora caulleryi</u>	0	1	0	0	0	0	0	0	0	0	0	0.1 ± 0.3	12.7
<u>Potamilla</u> sp	0	0	0	1	0	1	0	0	0	0	0	0.2 ± 0.4	38.2
<u>Scoloplos armiger</u>	0	0	0	0	0	0	0	0	1	0	0	0.1 ± 0.3	12.7
? <u>Spio</u> sp	0	0	1	0	0	0	0	0	0	1	0	0.2 ± 0.4	38.2
ARTHROPODA - Amphipoda													
<u>Tritella pilimana</u>	0	0	0	0	0	1	0	0	0	0	0	0.1 ± 0.3	12.7
MOLLUSCA - Pelecypoda													
<u>Clinocardium nuttallii</u> (juv.)	1	2	8	4	0	3	4	4	5	1	0	2.7 ± 1.7	343.8
<u>Macoma balthica</u>	31	32	52	33	28	44	39	40	23	31	0	33.4 ± 6.5	4252.6
<u>Macoma</u> sp	0	0	0	0	0	0	0	0	0	1	0	0.1 ± 0.3	12.7
<u>Mya arenaria</u>	1	0	0	0	0	1	1	0	0	0	0	0.3 ± 0.5	38.2
<u>Mya priapus</u>	0	0	0	1	0	0	0	0	0	0	0	0.1 ± 0.3	12.7
<u>Mya truncata</u>	0	0	0	0	0	0	1	0	0	0	0	0.1 ± 0.3	12.7
<u>Mya</u> spp (juv.)	13	12	13	6	5	35	9	17	2	8	0	11.9 ± 9.8	1515.2
<u>Pseudopythina</u> sp	0	1	0	0	0	0	1	1	1	1	0	0.5 ± 0.5	63.6
No. of Individuals	57	51	76	46	39	91	61	62	34	46	0		
No. of Species	8	7	6	6	3	9	8	4	7	9	0		

TAXA	Number Per Core Sample										Estimated	
											$x \pm s$	no./m ²
ECHIURIDAE												
<u>Echiurus echiurus</u>	0	1	1	0	0	0	0	0	0	0	0.2 ± 0.4	25.5
ANNELIDA - Polychaeta												
<u>Ampharete acutifrons</u>	0	0	1	1	0	0	0	0	1	0	0.4 ± 0.5	51.0
<u>Capitella capitata</u>	0	1	0	0	0	0	0	0	0	0	0.1 ± 0.3	12.7
<u>Eteone nr longs</u>	1	1	1	0	1	0	1	0	0	0	0.5 ± 0.5	63.8
<u>Eteone nr pacifica</u>	0	1	0	0	0	0	0	0	0	0	0.1 ± 0.3	12.7
<u>Harmothoe imbricata</u>	0	1	0	0	0	0	0	0	0	0	0.1 ± 0.3	12.7
<u>Malococeros</u> sp	0	0	0	0	0	0	1	0	0	1	0.2 ± 0.4	25.5
<u>Nephtys</u> sp	0	2	0	1	3	1	0	1	2	1	1.1 ± 1.0	140.1
<u>Nephtys</u> sp (juv)	1	0	2	1	0	0	1	1	1	1	0.8 ± 0.6	102.0
<u>Polydora caulleryi</u>	0	0	1	0	0	0	0	0	1	0	0.2 ± 0.4	25.5
<u>Potamilla</u> sp	0	0	0	0	0	0	0	1	0	0	0.1 ± 0.3	12.7
<u>Scoloplos armiger</u>	0	1	0	0	0	0	0	0	0	1	0.2 ± 0.4	25.5
<u>Spio filicornis</u>	1	3	1	1	0	0	1	3	0	0	1.0 ± 1.2	127.6
ANNELIDA - Oligochaeta												
	0	0	0	0	0	0	0	0	0	1	0.1 ± 0.3	12.7
ARTHROPODA - Crustacea												
<u>Crangon</u> sp	0	0	0	0	0	0	0	0	0	1	0.1 ± 0.3	12.7
<u>Tritella ?pilimana</u>	0	0	0	0	1	0	0	0	1	0	0.2 ± 0.4	25.5
MOLLUSCA - Pelecypoda												
<u>Clinocardium</u>												
<u>nuttallii</u> (adult)	0	0	0	0	0	0	0	1	0	0	0.1 ± 0.3	12.7
(juv)	0	0	0	0	0	0	0	1	1	0	0.2 ± (3.4)	25.5
<u>Macoma balthica</u>	14	20	22	14	21	18	15	21	17	15	17.7 ± 3.1	2253.6
<u>Mya arenaria</u>	1	0	0	0	2	0	0	1	1	0	0.5 ± 0.7	63.8
M. <u>priapus</u>	0	0	0	0	1	0	1	0	0	0	0.2 ± (3*4)	25.5
<u>Mya</u> sp (frag & juv.)	0	0	1	0	1	0	1	0	0	0	0.3 ± 0.5	38.2
<u>Pseudopythina</u> sp	0	2	3	0	0	0	1	1	0	0	0.7 ± 1.1	89.1
No. of Individuals	18	33	33	18	30	19	22	31	25	21		
No. of Species	5	10	9	4	6	2	7	8	7	6		

ABUNDANCE DATA FOR CORE SAMPLES FROM THE +2.5 FOOT LEVEL AT
GLACIER SPIT, **CHINITNA** BAY INTERTIDAL AREA; 30 JULY 1977

TAXA	Number Per Core Sample										X * S	Estimated no./m ²
ECHIURIDAE												
<u>Echiurus echiurus</u>	1	0	0	0	2	0	1	1	0	0	0.5 * 0.7	63.8
ANNELIDA - Polychaeta												
<u>Capitella capitata</u>	1	8	0	0	6	0	0	0	0	0	1.5 * 3.0	191.3
<u>Eteone nr longs</u>	1	4	3	2	3	0	0	1	0	0	1.4 ± 1.5	178.6
<u>Eteone nr pacifica</u>	2	0	0	0	0	0	0	0	0	0	0.2 ± 0.6	25.5
<u>Harmothoe imbricata</u>	1	0	1	0	1	0	0	1	0	0	0.4 ± 0.5	50.9
<u>Malococeros</u> sp	0	3	0	0	0	0	0	0	0	0	0.3 ± 0.9	38.3
Maldanidae (juv.)	0	1	0	0	0	0	0	0	0	0	0.1 ± 0.3	12.7
<u>Nephtys</u> sp (adults)	4	0	0	0	2	1	0	0	3	1	1.1 ± 1.4	140.3
(juv.)	1	8	2	4	0	1	0	1	1	2	2.0 ± 2.4	255.1
<u>Phyllodoce</u>												
<u>groenlandica</u>	0	0	0	0	0	0	2	0	0	0	0.2 ± 0.6	25.5
<u>Polydora caulleryi</u>	3	0	1	1	0	1	0	3	0	1	1.0 ± 1.2	127.5
<u>Potamilla</u> sp	4	1	0	4	0	1	2	0	0	0	1.2 ± 1.6	153.1
<u>Scoloplos armiger</u>	0	0	0	0	0	1	0	1	0	0	0.2 ± 0.4	25.5
<u>Spio filicornis</u>	6	4	4	5	3	1	1	9	3	2	3.8 ± 2.4	484.7
Spionidae, unid.	0	0	0	0	1	0	0	0	0	0	0.1 ± 0.3	12.7
ARTHROPODA - Crustacea												
<u>Crangon</u> sp	0	0	0	0	0	0	1	0	0	0	0.1 ± 0.3	12.7
Cyclopoida	0	0	0	0	0	0	0	1	0	1	0.2 ± 0.4	25.5
Harpacticoida	0	4	0	0	0	0	0	0	0	0	0.4 ± 1.3	50.9
Ischyroceridae	0	0	0	0	1	0	0	0	0	0	0.1 ± I)*3	12.7
<u>Tritella ?pilimana</u>	0	6	0	3	0	2	0	0	3	7	2.1 ± 2,6	267.9
Insects (larvae)	0	1	0	0	1	0	0	0	0	1	0.3 ± 0.5	38.3

+2.5 Foot Level Cont.

TAXA	Number Per Core Sample											x ± s	Estimated no./m ²	
MOLLUSCA - Pelecypoda														
<u>Clinocardium</u> <u>nuttallii</u> (adult)	0	0	0	1	0	0	1	1	1	0	1	0.4 ± 0.7	50.9	
(juv.)	0	1	0	0	0	0	0	0	1	0	0	0.2 ± 0.4	25.5	
<u>Macoma balthica</u>	10	28	29	20	22	17	18	21	15	14	19.4 ± 6.0	2470.1		
<u>Mya arenaria</u>	1	1	0	1	0	0	1		1	0	0	0.5 ± 0.5	63.8	
<u>M. priapus</u>	0	1	0	0	0	0	0		0	0	0	0.1 ± 0.3	12.7	
<u>Mya spp (frag. & juv.)</u>		1	0	0	1	0	2		0	0	1	1	0.6 ± 0.7	76.5
<u>Pseudopythina</u> sp	3	1	3	0	0	0	0			2	0	0	0.9 ± 1.2	114.6
No. of Individuals	39	72	43	42	42	27	27	46	26	31				
No. of Species	12	15	7	9	1	0	8	8	1	2	5	9		

ABUNDANCE DATA FOR CORE SAMPLES FROM THE +0.9 FOOT LEVEL AT
GLACIER SPIT, CHINITNA BAY INTERTIDAL AREA; 30 JULY 1977

TAXA	Number Per Core Sample										Estimated	
											$\bar{x} \pm s$	no./m ²
ECHIURIDAE												
<u>Echiurus echiurus</u>	0	1	1	0	0	1	0	0	2	0	0.5 ± 0.7	63.8
ANNELIDA												
<u>Ampharete acutifrons</u>	1	0	1	1	0	0	0	0	0	0	0.3 ± 0.5	38.3
<u>Capitella capitata</u>	1	0	1	0	0	11	0	0	0	0	1.3 ± 3.4	165.8
<u>Eteone nr longs</u>	0	2	1	1	0	4	0	0	2	0	1.0 ± 1.3	127.6
<u>Harmothoe imbricata</u>	2	1	0	2	0	1	1	2	1	0	1.0 ± 0.8	127.6
<u>Malacoceros</u> sp	1	2	0	0	0	0	0	0	0	0	0.3 ± 0.7	38.3
<u>Nephtys</u> sp (adult)	2	1	1	1	0	2	2	2	1	4	1.2 ± 0.8	153.1
(juv.)	2	1	0	0	0	1	1	1	0	0	0.6 ± 0.7	76.5
<u>Oligochaeta</u> , unid.	0	1	0	0	0	0	0	0	0	0	0.1 ± 0.3	12.7
<u>Phyllodoce</u> <u>groenlandica</u>	0	0	0	0	0	0	0	0	1	1	0.2 ± 0.4	25.5
<u>Polydora caulleryi</u>	0	0	1	0	0	0	0	0	0	0	0.1 ± 0.3	12.7
<u>Polygordius</u> sp	1	0	0	0	0	0	0	0	0	0	0.1 ± 0.3	12.7
<u>Potamilla</u> sp	6	2	6	8	4	2	5	2	0	1	3.6 ± 2.6	459.2
<u>Scoloplos armiger</u>	2	0	0	0	0	0	0	0	0	0	0.2 ± 0.6	25.5
<u>Spio filicornis</u>	14	2	6	2	1	5	12	0	1	1	4.4 ± 4.9	560.2
ARTHROPODA												
Acarin-a	0	0	0	0	0	1	0	0	0	0	0.1 ± 0.3	12.7
Cyclopoida	0	1	0	0	0	0	0	0	0	0	0.1 ± 0.3	12.7
<u>Pontoporeia femorata</u>	0	0	0	0	0	0	0	1	0	0	0.1 ± 0.3	12.7
<u>Tritella ?pilimana</u>	10	0	0	0	0	4	3	0	9	0	2.6 ± 3.9	331.6

+0.9 Foot Level Cont.

TAXA	Number Per Core Sample										x ± s	Estimated no./m ²
MOLLUSCA												
<u>Clinocardium</u>												
<u>nuttallii</u> (adult)	0	0	0	0	1	0	0	0	0	0	0.1 ± 0.3	12.7
(uv.)	1	0	2	5	0	0	3	0	1	0	1.2 ± 1.7	152.8
<u>Cylichna</u> sp	1	0	0	0	0	0		0	0	0	0.1 ± 0.3	12.7
<u>MaComa balthica</u>	31	22	15	14	23	22	19	24	9	26	20.5 ± 6.4	2610.3
<u>Mya arenaria</u>	0	1	0	1	1	0	1		0	0	0.4 ± 13.5	50.9
M. <u>priapus</u>	0	2	1	0	0	0	2		1	0	0.6 ± 0.8	76.4
M. <u>truncata</u>	0	0	2	1	0	0	0		0	0	0.3 ± 0.7	38.2
<u>Mya</u> spp (frag. & juv.)	1	0	1	2	1	1	2	1	0	1	1.0 ± 0.7	127.6
<u>Pseudopythina</u> sp	0	1	2	2	0	7	1	2	2	0	1.7 ± 2.0	216.5
No. of Individuals	76	40	41	40	31	62	52	36	29	34		
No. of Species	14	13	13	11	5	12	10	7	10	6		

ABUNDANCE DATA FOR CORE SAMPLES FROM THE -1.2 FOOT LEVEL AT
GLACIER SPIT, CHINITNA BAY INTERTIDAL AREA; 30 JULY 1977

TAXA	Number Per Core Sample										$\bar{x} \pm s$	Estimated no./m ²
ECHIURIDAE												
<u>Echiurus echiurus</u>	1	0	0	0	0	0	0	0	0	0	0.1 ± 0.3	12.7
ANNELIDA - Polychaeta												
<u>Ampharete acutifrons</u>	0	0	0	0	0	1	0	0	1	0	0.2 ± 0.4	25.5
<u>Axiiothella rubrocincta</u>	0	1	0	0	0	0	0	0	0	0	0.1 ± 0.3	12.7
<u>Capitella capitata</u>	1	0	1	0	0	0	3	0	0	1	0.6 ± 1.0	76.5
<u>Eteone nr longs</u>	2	0	0	1	1	0	3	1	0	1	0.9 ± 1.0	114.8
<u>Harmothoe imbricata</u>	1	0	1	0	0	0	1	1	0	1	0.5 ± 0.5	63.8
<u>Malacoceros sp</u>	0	0	0	0	0	1	2	0	0	1	0.4 ± 0.7	51.0
<u>Nephtys sp</u>	0	1	0	2	0	2	1	2	2	1	1.1 ± 1.1	140.3
<u>Nephtys sp (juv.)</u>	2	6	2	3	0	6	3	0	2	1	2.5 ± 2.1	318.9
<u>Paraonella platybranchia</u>	0	0	0	0	0	0	2	0	0	0	0.2 ± 0.6	25.5
<u>Phyllodoce groenlandica</u>	0	2	0	1	0	0	0	0	1	1	0.5 ± 0.7	63.8
<u>Polydora caulleryi</u>	1	1	0	0	0	1	1	0	0	0	0.4 ± 0.5	50.9
<u>Potamilla sp</u>	3	5	4	3	0	1	2	5	3	4	3.0 ± 1.6	382.0
<u>Scoloplos armiger</u>	1	0	0	0	0	1	0	0	0	0	0.2 ± 0.4	25.5
<u>Spio filicornis</u>	4	13	10	3	0	5	4	3	6	3	5.1 ± 3.8	650.5
NEMERTEA, unid.	0	0	0	1	0	0	0	1	0	0	0.2 ± 0.4	25.5
ARTHROPODA												
<u>Acarina</u>	0	0	1	0	0	0	0	0	0	0	0.1 ± 0.3	12.7
<u>Pontoporeia femorata</u>	0	0	0	0	0	0	1	0	0	0	0.1 ± 0.3	12.7
<u>Tritella ?pilimana</u>	7	1	0	0	0	0	1	0	0	1	1.0 ± 2.2	127.6

-1.2 Foot Level Cont.

TAXA	Number Per Core Sample											Estimated	
												x ± s	no./m ²
MOLLUSCA													
<u>Aglaja diomadea</u>	0	0	0	0	0	0	0	0	0	0	1	0.1 ± 0.3	12.7
<u>Clinocardium</u>													
<u>nuttallii</u> (adult)	0	0	1	0	0	0	0		0	0	0	0.1 ± 0.3	12.7
(juv.)	2	2	1	0	1	3	2		1	0	1	1.3 ± 0.9	165.5
<u>Macoma balthica</u>	50	19	30	21	28	27	23	20	18	22	25.8 ± 9.4	3285.0	
<u>Mya arenaria</u>	0	0	0	0	1	0	0		0	0	0	0.1 ± 0.3	12.7
M. <u>priapus</u>	0	0	0	2	0	2	0		0	0	1	0.5 ± 0.8	63.8
M. <u>truncata</u>	0	0	0	0	1	1	0		0	0	0	0.2 ± 0.4	25.5
<u>Mya spp (frag. & juv.)</u>	2	1	1	0	1	2	3	0	0	1	1.1 ± 0.1	140.1	
<u>Pseudopythina</u> sp	00	1	0	0	2	4	2	0	2	1.1 ± 1.3	140.1		
No. of Individuals	77	52	53	37	33	55	56	36	33	43			
No. of Species	13	10	10	8	5	12	15	9	6	14			

APPENDIX VIIa. BIOMASS DATA (GRAMS WHOLE WET WEIGHT) FOR CORE SAMPLES FROM GLACIER SPIT, CHINITNA BAY, 6 APRIL 1977

TAXA	1	2	3	4	5	6	7	8	9	10	x ± s	Biomass/m ²
+3.6 Level												
ECHIURA												
<u>Echiurus echiurus</u>	0	0.377	0	0	0	0	0	0	0	0	0.038 ± 0.119	4.838
ANNELIDA - Polychaeta												
<u>Abarenicola pacifica</u>	0	0	0	0	0	0	0	0	0	0.024	0.002 ± 0.008	0.255
<u>Capitella capitata</u>	0	0	0	0	0.007	0	0	0	0	0	0.001 ± 0.002	0.127
<u>Eteone nr longs</u>	0	0	T	0	0	0	0	0	0.090	0	0.009 ± 0.028	1.146
<u>Glycinde</u> sp	0	0	0	0	0.001	0	0	0	0	0.047	0.005 ± 0.015	0.637
<u>Harmothoe imbricata</u>	0	0	0	0	0	0	0	0	0	0.007	0.001 ± 0.002	0.127
<u>Malacocerus</u> sp	0	0	0	0	0.001	0	0	0	0	0	T	T
<u>Nephtys</u> sp	0.005	0	0	0.14	0.726	0.054	0.139	0.10	0.005	0	0.017 ± 0.222	2.165
<u>Nephtys</u> sp (juv.)	0	0	T	0	T	T	T	0	0	0	T	0.026
Paraonidae, unid.	T	0	0	0	0	0	0	0	0	0	T	T
<u>Phyllodoce</u>												
<u>groenlandica</u>	0	0	0	0	0.017	0	0	0	0	0	0.002 ± 0.005	0.255
<u>Potamilla</u> sp	0	0.001	0	0	0.063	0	0	0	0	-	0.006 ± 0.020	0.764
ARTHROPODA - Crustacea												
Arthropod frag.	0	0	0	0.002	0	0	0	0	0	0	T	0.025

TAXA	1	2	3	4	5	6	7	8	9	10	X ± S	Biomass/m ²
+3.6' Level Cont.												
MOLLUSCA - Pelecypoda												
<u>Clinocardium nuttallii</u> (juv.)	0	0.005	0	0.005	0.02	0	0	0	0	0.005	0.004 ± 0.006	0.509
<u>Macoma balthica</u>	4.32	4.69	2.31	4.59	4.00	3.48	3.33	2.55	5.50	7.88	4.3 ± 1.6	547.5
<u>Mya arenaria</u>	0	0	0	0	24.11	71.07	62.84	107.77	0	14.22	28.0 ± 38.8	3565.1
<u>Mya</u> spp (juv.)	0	0	0	0.005	0.05	0	0.01	0	0	0.01	0.008 ± 0.016	1.02
<u>Mya</u> sp (frag.)	0	0	0	0	0	0	3.03	0	0	0	0.3 ± 1.0	38.2
<u>Pseudopythina</u> sp	0	0.006	0.005	0	0.03	n	"o	o	o	0.02	0.006 ± 0.011	0.76
Total	4.33	5.08	2.32	4.74	29.03	74.60	69.35	110.42	5.60	22.21	32.75 ± 38.35	4169.5"
+2.5' Level												
ECHIUURA												
<u>Echiurus echiurus</u>	0.135	0	0.690	1.24	0	0.90	0.025	0.360	0.291	0	0.364 ± 0.439	46.35
ANNELIDA - Polychaeta												
Aphroditoidae, unid.	0.002	0	0	0	0	0.126	0	0	0.095	0	0.022 ± 0.047	2.801
<u>Capitella capitata</u>	o	0.001	0	0	0	0	0	0	0	0	T	T
<u>Eteone</u> nr <u>longa</u>	o	0.022	0	0	0.012	0.010	0	0.004	0	0	0.005 ± 0.008	0.637
<u>Glycinde</u> sp	o	0	0.075	0.006	0	0	0	0.030	0	0	0.011 ± 0.024	1.401
<u>Harmothoe imbricata</u>	o	0	0	0	0	0.029	0	0	0	0	0.003 ± 0.009	0.382

TAXA	1	2	3	4	5	6	7	8	9	10	x ± s	Biomass/m ²
+2.5' Level Cont.												
<u>Nephtys caeca</u>	0.42	0.890	0.146	0	0.322	0.494	0	0	0.177	0.09	0.254 ± 0.285	32.34
<u>Nephtys</u> sp (juv.)	0.038	0.007	0.0	0	0	0	0.002	0.005	0.003	0.005	0.007 ± 0.011	0.891
<u>Polydora caulleryi</u>	0	0	0	0	0.003	0	0	0	0.002	0	T	0.06
<u>Potamilla</u> sp	0	0.017	0.040	0.008	0.022	0	0.003	0	0	0.034	0.012 ± 0.015	1.528
MOLLUSCA - Pelecypoda												
<u>Clinocardium</u> <u>nuttallii</u> (juv.)	0	0.005	0.01	0	0	0	0.01	0	0.01	0	0.004 ± 0.005	0.509
<u>Macoma balthica</u>	5.12	4.91	3.28	2.49	6.45	3.93	3.67	4.20	3.55	4.90	4.2 ± 1.1	534.7
<u>Mya arenaria</u>	0	51.61	0	7.17	0	0	0	62.62	39.20	9.86	17.0 ± 24.4	2164.5
<u>M. priapus</u>	0	0	0	0	0	7.05	0	0	6.10	0	1.3 ± 2.8	165.5
<u>Mya</u> sp (frag.)	0	0	0	0	0	0	0	0	0	0.84	0.08 ± 0.27	10.19
<u>Mya</u> spp (juv.)	0.01	0.02	0	0	0.02	0	0	0.005	0	0.6	0.07 ± 0.19	8.91
<u>Pseudopythina</u> sp	0	0.07	0.02	0.22	0	0	0	0.01	0.02	0	0.034 ± 0.07	4.33
Total	5.73	57.55	4.27	11.13	6.83	12.54	3.71	67.23	49.45	16.33	23.48 ± 24.55	2989.33

TAXA	1	2	3	4	5	6	7	8	9	10	x ± s	Biomass/m ²
+0.9' Level												
ECHIURA												
<u>Echiurus echiurus</u>	0	0	0	0	0	0	0	0	1.099	0	0.110 ± 0.348	14.006
ANNELIDA - Polychaeta												
<u>Ampharete acutifrons</u>	0.010	0	0	0	0	0	0	0	0	0.001	0.001 ± 0.003	0.127
<u>Capitella capitata</u>	0.001	0	0	0	0	0	0	0	T	0	0.0001 ± 0.0003	0.013
<u>Eteone nr longs</u>	0	0	0	0.004	0	0.003	0	0	0.001	0	0.001 ± 0.001	0.127
<u>Glycinde sp</u>	0.020	0.005	0	0	0	0	0	0	0.050	0.070	0.015 ± 0.025	1.910
<u>Harmothoe imbricata</u>	0	0	0	0	0	0	0	0	0.195	0	0.020 ± 0.062	2.546
<u>Malacocerus sp</u>	0	0	0	0	0	0	0	0	0	0.001	0.0001 ± 0.0003	0.013
<u>Nephtys sp</u>	0.040	0	0.575	0.450	0.35	0.238	-	-	0.245	0.093	0.288 ± 0.189	29.03
<u>Nephtys sp (juv.)</u>	0.001	0.006	0.006	0.012	0	0.004	0.239	0.051	0.040	0.020	0.009 ± 0.013	1.146
<u>Phyllodoce groenlandica</u>	0	0.409	0.007	0	0	0	0	0.011	0	0.035	0.046 ± 0.128	5.857
<u>Polydora caulleryi</u>	0	0	0	0	0	0	0.004	0	0	0	0.0004 ± 0.001	0.051
<u>Potamilla sp</u>	0.046	0.012	0.020	0.182	0.030	0.005	0.032	0.011	0.061	0.012	0.041 ± 0.053	5.220
<u>Spionidae, unid.</u>	0	0	0	0	0	0	0	0	0	0.002	T	0.025
MOLLUSCA - Pelecypoda												
<u>Clinocardium nuttallii (juv.)</u>	0.1	0.01	-	0.02	0.02	0.01	0.01	0.0.1	0.01	0.01	0.02 ± 0.03	2.55
<u>Macoma balthica</u>	3.58	4.89	4.16	5.19	3.82	3.94	6.64	1.70	5.01	3.92	4.3 ± 1.3	547.5

TAXA	1	2	3	4	5	6	7	8	9	10	X * S	Biomass/m ²
+0.9' Level Cont.												
<u>Mya priapus</u>	0	0	o	0	0	2.37	0	0	0	0	0.2 ± 0.7	25.5
Mya sp (frag.)	4.29	0	33.83	0.96	0	0	0	0	0	0	3.91 ± 10.6	497.8
<u>Mya</u> spp (juv.)	0.005	0.01	0.03	0.07	0.14	0.075	0.10	0.06	0.10	0.17	0.07 ± 0.06	8.9
<u>Pseudopythina</u> sp	0	0.01	0	0	0	0	0.03	0.02	0.02	0.06	0.014 ± 0.02	1.78
Total	8.09	5.35	38.63	6.89	4.36	6.65	7.06	1.86	6.83	4.39	9.01 ± 10.56	1147.37
-1.2' Level												
ECHIURA												
<u>Echiurus Echiurus</u>	0.001	0	o	0	0	0	0	0	2.05	0	0.205 ± 0.648	26.101
ANNELIDA - Polychaeta												
<u>Ampharete acutifrons</u>	0	0	0.002	0	0	0	0	0	0	0.003	0.0005 ± 0.001	0.064
<u>Capitella capitata</u>	0	0	0	0	0	0	T	o	0	0	T	T
<u>Eteone nr longs</u>	0	0.001	0	0	0	0.006	0	0.009	0	0	0.002 ± 0.003	0.255
<u>Glycinde</u> sp	0.001	0	0	0	0	0.004	0.055	0	0.005	0	0.007 ± 0.017	0.891
<u>Malacocerus</u> sp	0	0	0	0	0	0	0	0	0	T	T	T
<u>Nephtys caeca</u>	0.419	-	0.506	0.682	0.178	0	0.496	0.270	0.095	0	0.356 ± 0.302	45.327
<u>Nephtys</u> sp (juv.)	0.012	0.910	0	0	0.005	0.011	0.006	0	0	0.001	0.004 ± 0.005	0.509
<u>Phyllodoce groenlandica</u>	0.015	0	0	0	0	0	0	0	0	0	0.002 ± 0.005	0.191

TAXA	1	2	3	4	5	6	7	8	9	10	x ± s	Biomass/m ²
-1.2 Level Cont.												
<u>Polydora caulleryi</u>	o	0.001	o	o"	o	0	0	0	0	0	0.0001 ± 0.0003	0.013
<u>Potamilla</u> sp	0	0	0	0.028	0.001	0.012	0.043	0	0	0	0.008 ± 0.015	1.019
<u>Scoloplos armiger</u>	0	0	0	0	0	0	0	0	0.004	0	0.0004 ± 0.001	0.051
? <u>Spio</u> sp	0	0	0.004	0	0	0	0	0	0	0	0.0004 ± 0.001	0.051
ARTHROPODA - Crustacea												
<u>Tritella pilimana</u>	0	0	0	" 0	o	0.005	0	0	0	" 0	0.0005 ± 0.002	0.064
MOLLUSCA - Pelecypoda												
<u>Clinocardium nuttallii</u> (juv.)	0.005	0.01	o	0.01	0	0.1	0.01	0.02	0.02	0.05	0.02 ± 0.03	2.55
<u>Macoma balthica</u>	2.55	3.54	0	4.48	1.19	2.30	3.67	5.21	1.40	2.54	2.7 ± 1.6	342.3
<u>Mya arenaria</u>	0.99	0	0	0	0	11.15	0.68	0	0	0	1.3 ± 3.5	163.2
<u>M. priapus</u>	0	0	0	0.03	0	0	0	o	o	0	0.003 ± 0.01	0.382
<u>M. truncata</u>	0	0	0	0	0	0	24.34	0	0	0	2.4 ± 7.7	309.9
<u>Mya</u> spp (juv.)	0.13	0.14	0	0.13	0.07	0.32	0.05	0.13	0.02	0.07	0.11 ± 0.09	13.5
<u>Pseudopythina</u> sp	0	0	0	0	0	0	0.02	0.01	0.01	0.02	0.006 ± 0.009	0.76
Total	4.12	4.60	0.51	5.36	1.44	13.91	29.37	5.65	3.60	2.68	7.12 ± 8.63	906.9

APPENDIX VIIb. BIOMASS DATA (GRAMS WHOLE WET WEIGHT) FOR CORE SAMPLES FROM GLACIER SPIT, CHINITNA BAY, 30 JULY 1977

TAXA	1	2	3	4	5	6	7	8	9	10	x ± s	Biomass/m ²
+3.6' Level												
ECHIURA												
<u>Echiurus echiurus</u>	0	1.52	0.65	0.01	0	0	0	0	o	0	0.22 ± 0.05	27.76
ANNELIDA												
<u>Ampharete acutifrons</u>	0.01	0	T	T	o	0	0	0	0.01	0	T	T
<u>Capitella capitata</u>	0	T	o	0	0	0	0	0	0	0	T	T
<u>Eteone nr longa</u>	0.014	0.007	T	0	T	o	T	o	0	0	0.002 ± 0.005	0.267
<u>Eteone nr pacifica</u>	0	0.008	0	0	0	0	0	0	0	0	0.001 ± 0.003	0.102
<u>Harmothoe imbricata</u>	0	0.17	0	0	0	0	0	0	0	0	0.017 ± 0.054	2.165
Hirudinea, unid.	0	0.015	0	0	0	0	0	0	0	0	0.002 ± 0.005	0.19
? <u>Malacocerus</u> sp	0	0	0	0	0	0	T	o	0	T	T	T
<u>Nephtys</u> sp	0	0.49	0	0.20	0.52	0.35	0	0.31	0.65	1.39	0.39 ± 0.42	49.78
<u>Nephtys</u> sp (juv.)	T	0	0.005	T	o	0	0.265	T		0.003	0.027 ± 0.084	3.48
<u>Oligochaeta</u> , unid.	o	0	0	o	0	0	0	0	0	T	T	T
<u>Polydora caulleryi</u>	0	0	T	0	0	0	0	0	T	o	T	T
<u>Potamilla</u> sp	0	o	0	0	0.0	0	0	T	0.002	0	0.001 ± 0.003	0.153
<u>Scoloplos armiger</u>	0	T	o	o	0	0	0	0	0	0.005	0.001 ± 0.002	0.064
<u>Spio filicornis</u>	0.004	T	T	T	o	0	T	T	0	0	0.001 ± 0.002	0.122

TAXA	1	2	3	4	5	6	7	8	9	10	x ± s	Biomass/m ²
+2.5' Level Cont.												
<u>Harmothoe imbricata</u>	0.24	0	0.34	0	0.326	0	0	0.08	0	0	0.099 ± 0.145	12.55
?Maldanidae (juv.)	0	T	o	0	T	0	0	0	0	0	T	T
<u>Malococerus sp</u>	0	T	o	0	o	0	0	0	0	0	T	T
<u>Nephtys sp</u>	0.404	0	0	0	0.394	0.84	0	0	0.84	0.14	0.26 ± 0.34	33.33
<u>Nephtys sp (juv.)</u>		0.012	0.02	0.02	T	0.02	0	T	0.014	-	0.009 ± 0.009	1.12
<u>Phyllodoce</u>												
<u>groenlandica</u>	0	0	0	0	o	0	0.384	0	0	0.08	0.046 ± 0.121	5.908
<u>Polydora caulleryi</u>	T	0	T	T	0	T	o	T	o	T	T	T
<u>Potamilla sp</u>	0.055	0.026	0	0.11	0	T	0.02	o	0	0	0.021 ± 0.036	2.687
<u>Scoloplos armiger</u>	0	0	0	0	0	T	o	T	o	0	T	T
<u>Spio filicornis</u>	0.018	T	0.01	0.01	0.016	T	T	0.03	0.007	T	0.009 ± 0.010	1.21
?Spionidae, unid.	0	0	0	0	T	o	0	o	0	0	T	T
MOLLUSCA - Pelecypoda												
<u>Clinocardium</u>												
<u>nuttallii</u> (adult)	0	0	0	7.79	o	0	3.32	9.83	0	7.01	2.8 ± 3.9	355.9
<u>C. nuttallii</u> (juv.)	0	0.005	0	0	0	0	0	0.34	0	0	0.04 ± 0.11	4.4
<u>Macoma balthica</u>	1.85	5.15	4.76	3.93	4.28	1.95	2.89	2.86	2.27	4.46	3.4 ± 1.2	438.0
<u>Mya arenaria</u>	81.07	19.35	0	68.66	0	0	8.05	13.06	0	0	19.0 ± 30.3	2421.7
M. <u>priapus</u>	0	9.39	0	0	0	0	0	0	0	0	0.9 ± 3.0	119.6
<u>Mya spp.</u> (juv.)	T	0	0	0	0	0.14	0	0	0.36	0	0.05 ± 0.12	6.4

TAXA	1	2	3	4	5	6	7	8	9	10	x ± s	Biomass/m ²
+2.5' Level Cont.												
<u>Mya</u> sp (frag.)	0	0	0	4.50	0	0	0	5.75	0	49.21	5.9 ± 15.3	757.1
<u>Pseudopythina</u> sp	0.27	0.02	0.06	0	0	0	0	0.24	0	0	0.06 ± 0.11	7.5
Total	85.18	33.97	5.62	85.02	6.64	2.95	14.76	33.00	3.49	60.90	33.16 ± 32.93	4221.7
+0.9' Level												
ECHIURA												
<u>Echiurus echiurus</u>	0	1.09	0.23	0	0	0.950	0	0	1.65	0	0.314 ± 0.590	40.036
ANNELIDA												
<u>Ampharete acutifrons</u>	T	0	T	T	0	0	0	0	0	0	T	T
<u>Capitella capitata</u>	0.015	0	T	0	0	0.015	0	0	0	0	0.003 ± 0.006	0.382
<u>Eteone</u> nr <u>longs</u>	0	0.007	T	0.005	0	0.033	0	0	0.023	0	0.007 ± 0.012	0.866
<u>Harmothoe imbricata</u>	0.030	0.285	0	0.03	0	0.05	0.022	0.40	0.03	0	0.083 ± 0.141	10.530
<u>Malacocerus</u> sp	T	0.002	0	0	0	0	0	0	0	0	T	0.032
<u>Nephtys</u> sp	0.986	0.383	0.065	0.930	0	1.614	0.844	0.36	1.75	0.35	0.728 ± 0.607	92.717
<u>Nephtys</u> sp (juv.)	0.006	-	0	0	0				0	0	0.001 ± 0.002	0.076
<u>Oligochaeta</u> , unid.	0	0.07	0	0	0	0	0	0	0	0	0.007 ± 0.022	0.891
<u>Phyllodoce</u> <u>groenlandica</u>	0	0	0	0	0	0	0	0	0.645	T	0.072 ± 0.215	9.125
<u>Polydora caulleryi</u>	0	0	0.007	0	0	0	0	0	0	0	0.001 ± 0.002	0.089

TAXA	1	2	3	4	5	6	7	8	9	10	x ± s	Biomass/m ²
+0.9' Level Cont.												
<u>Polygordius</u> sp	T	o	0	0	0	0	0	"	0	0	T	T
<u>Potamilla</u> sp	0.155	0.07	0.10	0.21	0.105	0.018	0.06	0.09	0	0.002	0.081 ± 0.067	10.313
<u>Scoloplos</u> armiger	T	o	0	0	0	0	0	0	0	0	T	T
<u>Spio filicornis</u>	0.037	0.008	0.009	0.01	T	0.010	0.017	0	0.004	0.014	0.011 ± 0.011	1.389
Spionidae, unid.	0	0.008	0	0	0	0	0	0	0	0	0.001 ± 0.003	0.102
MOLLUSCA - Pelecypoda												
<u>Clinocardium</u> <u>nuttallii</u> (adult)	0	0	0	0	25.50	0	0	0	0	0	2.6 ± 8.1	324.6
<u>C. nuttallii</u> (juv.)	0.15	0	0.007	4.00	0	0	0.01	0	0.005	0	0.02 ± 0.05	3.1
<u>Macoma balthica</u>	4.79	4.35	1.57	2.23	3.68	2.81	4.38	4.50	0.28	3.59	3.2 ± 1.5	409.6
<u>Mya arenaria</u>	0	39.16	0	23.00	20.80	0	11.29	0	0	0	9.4 ± 13.9	1199.8
M. <u>priapus</u>	0	41.22	17.78	0	0	0	5.35	19.89	0	0	8.4 ± 100	1072.5
M. <u>truncata</u>	0	0	24.54	14.75	0	0	0	0	0	0	3.9 ± 8.6	501.1
<u>Mya</u> spp (juv.)	0	0	0.04	0.14	0	0.54	0	0	0	0	0.2 ± 0.3	30.8
<u>Mya</u> sp (frag.)	28.34	0.79	0	40.97	0.65	0	10.87	9.67	0	0	9.1 ± 14.4	1162.4
<u>Pseudopythina</u> sp	0	0.005	0.03	0.005	0	0.17	0.005	0.59	0.01	0	0.08 ± 0.19	10.4
Total	34.51	87.38	44.38	86.28	50.74	6.21	32.83	35.50	4.40	3.96	38.62 ± 30.39	4917.36

TAXA	1	2	3	4	5	6	7	8	9	10	x ± s	Biomass/m ²
-1.2' Level												
ECHIURA												
<u>Echiurus echiurus</u>	0.520	0	0	0	0	0	0	0	0	0	0.052 ± 0.164	6.621
ANNELIDA												
<u>Ampharete acutifrons</u>	0	0	0	0	0	T	0	0	T	0	T	T
<u>Axiothella rubrocincta</u>	0	T	0	0	0	0	0	0	0	0	T	T
<u>Capitella capitata</u>	0.001	0	0.001	0	0	0	0.001	0	0	0	0.0003 ± 0.0004	0.038
<u>Eteone nr longs</u>	0.012	0	0	0.002	0	0.01	0.009	0.001	0	0.003	0.004 ± 0.005	0.471
<u>Harmothoe imbricata</u>	0.003	0	0.046	0	0	0	0.507	0.008	0	0.007	0.057 ± 0.159	7.270
<u>Malococerus sp</u>	0	0	0	0	0		T	0	0	T	T	T
<u>Nephtys sp</u>	0.597	0.345	0.170	0.675	0	0.61	0.060	1.263	0.070	1.38	0.462 ± 0.510	58.836
<u>Nephtys sp (juv.)</u>		0.014			0	0.018		0			0.003 ± 0.007	0.407
<u>Paraonella platybranchia</u>	0	0	0	0	0	0	T	0	0	0	T	T
<u>Phyllodoce groenlandica</u>	0	0.015	0	0.003	0	0	0	0	0.074	0.003	0.010 ± 0.023	1.210
<u>Polydora ?caulleryi</u>	0.002	T	0	0	0	T	T	0	0	0	0.0002 ± 0.001	0.045
<u>Potamilla sp</u>	0.104	0.196	0.012	0.053	0	0.043	0.014	0.028	0.010	0.034	0.049 ± 0.060	6.290
<u>Scoloplos armiger</u>	0.002	0	0	0	0	0.003	0	0	0	0	0.001 ± 0.001	0.064
<u>Spio filicornis</u>	0.022	0.020	0.02	T	0	0.011	0.005	0.007	0.007	0.004	0.010 ± 0.008	1.229

TAXA	1	2	3	4	5	6	7	8	9	10	x ± s	Biomass/m ²	
-1.2' Level Cont.													
ARTHROPODA - Crustacea													
<u>Tritella</u> ?pilimana	T	T	o	0	0	0	0	0	0	T	T	T	
MOLLUSCA - Pelecypoda													
<u>Clinocardium</u> <u>nuttallii</u> (adult)	0	0	2.10	0	0	0	0	0	0	0	0.2 ± 0.7	26.7	
<u>C. nuttallii</u> (juv.)	0.25	0.04	0.005	0	0.44	1.20	1.15	0.005	0	0.005	0.3 ± 0.5	39.4	
<u>Macoma balthica</u>	6.52	3.03	6.88	3.93	4.89	5.04	2.86	3.49	2.33	3.80	4.3 ± 1.5	544.5	
<u>Mya arenaria</u>	0	0	0	0	85.56	0	0	0	0	0	8.6 ± 27.1	1089.2	
<u>M. priapus</u>	0	0	0	25.47	0	34.08	0	0	0	23.70	8.3 ± 13.7	1059.8	
<u>M. truncata</u>	0	0	0	0	34.58	17.47	0	0	0	0	5.2 ± 11.7	662.6	
<u>Mya</u> spp (juv.)	0.01	0.04	1.40	0	0.81	0.25	0.43	0	0	0.19	0.3 ± 0.5	39.8	
<u>Mya</u> sp (frag.)	2.29	0	o	0	0	0	0	0	0	0	0.2 ± 0.7	29.2	
<u>Pseudopythina</u> sp	0	0	T	o	-	o	0.01	0.07	0.01	0	0.15	0.03 ± 0.05	3.2
Total	10.33	3.70	10.63	30.13	126.28	58.75	5.11	4.81	2.49	29.28	28.15 ± 38.77	3584.5	

APPENDIX VIIIa.

SUMMARY OF DENSITY OF ORGANISMS IN INFAUNAL
SAMPLES BY LEVEL AT GLACIER SPIT, CHINITNA
BAY, 6 APRIL 77

TAXA	Number per m ²			
	+3.6'	+2.5'	+0.9'	-1.2'
ECHIURA				
<u>Echiurus echiurus</u>	12.7	101.9	12.7	25.5
ANNELIDA - Polychaeta				
<u>Abarenicola pacifica</u>	12.7	0	0	0
<u>Ampharete acutifrons</u>	0	0	25.5	25.5
<u>Aphroditoididae, unid.</u> <u>(?Peisidice)</u>	0	38.2	0	0
<u>Capitella capitata</u>	12.7	25.5	25.5	12.7
<u>Eteone nr longis</u>	38.2	50.9	38.2	25.5
<u>Glycinde polygnatha</u>	25.5	38.2	0	38.2
<u>Harmothoe imbricata</u>	12.7	12.7	12.7	0
<u>Malacoceros sp</u>	38.2	0	12.7	12.7
<u>Nephtys sp</u>	63.7	89.1	165.5	127.3
<u>Nephtys sp (juv)</u>	89.1	140.1	211.7	267.4
<u>paraonidae, unid.</u>	12.7	0	0	0
<u>Phyllodoce groenlandica</u>	25.5	0	25.5	12.7
<u>Polydora caulleryi</u>	0	25.5	25.5	12.7
<u>Potamilla sp</u>	63.7	76.4	318.3	38.2
<u>Scoloplos armiger</u>	0	0	0	12.7
<u>?Spio filicornis</u>	0	0	0	38.2
MOLLUSCA - Pelecypoda				
<u>Clinocardium nuttallii</u>	63.7	50.9	432.9	345.8
<u>Macoma balthica</u>	4647.3	4443.6	5347.6	4252.6
<u>Macoma sp</u>	0	0	0	12.7
<u>Mya arenaria</u>	89.1	63.6	0	38.2
<u>M. priapus</u>	0	25.5	12.7	12.7
<u>M. truncata</u>	0	0	0	12.7
<u>Mya spp. (juv)</u>	152.8	127.3	1120.5	1515.2
<u>Pseudopythina. Sp</u>	89.1	203.7	229.2	56.6
ARTHROPODA - Crustacea				
<u>Saduria entomon</u>	0	12.7	0	0
<u>Tritella pilimana</u>	0	0	0	12.7

APPENDIX VIIIb.

SUMMARY OF DENSITY OF ORGANISMS IN INFAUNAL
SAMPLES BY LEVEL AT GLACIER SPIT, CHINITNA
BAY, 30 JULY 77

TAXA	Number per m ²			
	+3.6'	+2.5'	+1.9'	-1.2'
ECHIURA				
<u>Echiurus echiurus</u>	25.5	63.8	63.8	12.7
NEMERTEA, unid	0	0	0	25.5
ANNELIDA <u>Oligochaeta,</u> unid.	12.7	0	12.7	0
ANNELIDA Polychaeta				
<u>Ampharete acutifrons</u>	51.0	0	38.3	25.5
<u>Axiothella rubrocincta</u> c		0	0	12.7
<u>Capitella capitata</u>	12.7	191.3	165.8	76.5
<u>Eteone nr longa</u>	63.8	178.6	127.6	114.8
<u>E. nr pacifica</u>	12.7	25.5	0	0
<u>Harmothoe imbricata</u>	12.7	50.9	127.6	63.8
<u>Malacoceros</u> sp	25.5	38.3	38.3	51.0
Maldanidae, unid.	0	12.7	0	0
<u>Nephtys</u> sp	140.1	140.3	153.1	140.3
<u>Nephtys</u> sp (juv.)	102.0	255.1	76.5	318.9
<u>Paraonella platybranchia</u>	0	0	0	25.5
<u>Phyllodoce groenlandica</u>	0	25.5	25.5	63.8
<u>Polydora caulleryi</u>	25.5	127.5	12.7	50.9
<u>Polygordius</u> sp	0	0	12.7	0
<u>Potamilla</u> sp	12.7	153.1	459.2	382.0
<u>Scoloplos armiger</u>	25.5	25.5	25.5	25.5
<u>Spio filicornis</u>	127.6	484.7	560.2	650.5
Spionidae, unid.	0	12.7	0	0
ARTHROPODA				
Acarina, unid.	0	c	12.7	12.7
<u>Crangon</u> sp	12.7	12.7	0	0
Harpacticoidea, unid.	0	25.5	0	0
Ischyroceridae, unid.	0	50.9	0	0
<u>Pontoporeia femorata</u>	0	12.7	12.7	12.7
<u>Tritella ?pilimana</u>	25.5	267.9	331.6	127.6

TAXA	Number per m ²			
	<u>+3.6'</u>	<u>+2.5'</u>	<u>+0.9'</u>	<u>-1.2'</u>
MOLLUSCA				
<u>Aglaja diomedea</u>	0	0	0	12.7
<u>Clinocardium nuttallii</u> (adult)	12.7	50.9	12.7	12.7
<u>C. nuttallii</u> (juv)	25.5	25.5	152.8	165.5
<u>Cylichna</u> sp	0	0	12.7	0
<u>Macoma balthica</u>	2253.6	2470.1	2610.3	3285.0
<u>Mya arenaria</u>	63.8	63.8	50.9	12.7
<u>M. priapus</u>	25.5	1.2.7	76.4	63.8
<u>M. truncatus</u>	0	0	38.2	25.5
<u>Mya spp</u> (juv)	12.7	50.9	76.4	127.3
<u>Pseudopythina</u> sp	89.1	114.6	216.5	140.1

APPENDIX IX.

SUMMARY OF BIOMASS DISTRIBUTION AMONG ORGANISMS AND LEVELS AT GLACIER
SPIT, CHINITNA BAY IN 1977

TAXA	Grams wet weight per m ²							
	6 April				30 July			
	+3.6'	+2.5'	+0.9'	-1.2'	i-3.6'	+2.5'	+0.9'	-1.2'
ECHIURA	(0.1%)	(1.6%)	(1.2%)	(2.9%)	(0.8%)	(1.3%)	(0.8%)	(0.1%)
<u>Echiurus echiurus</u>	4.84	46.35	14.01	26.10	27.76	52.78	40.04	6.62
ANNELIDA - Polychaeta	(0.1%)	(1.2%)	(4.0%)	(5.3%)	(1.6%)	(1.4%)	(2.5%)	(2.1%)
<u>Ampharete acutifrons</u>	0	0	(.13)	0.06	T	0	T	T
<u>Capitella capitata</u>	0.13	T	0.01	T	T	0.17	0.38	0.04
<u>Eteone nr longa</u>	1.15	0.64	0.13	0.26	0.27	1.30	0.87	0.47
<u>Glycinde polygnatha</u>	0.64	1.40	1.91	0.89	0	0	0	
<u>Harmothoe imbricata</u>	0.13	0.38	2.55	0	2.17	12.55	10.53	7.27
<u>Malacoceros sp</u>	T	0	0.01	T	T	T	0.03	T
<u>Nephtys sp</u>	2.17	32.34	29.03	45.33	49.78	33.33	92.72	58.84
<u>Nephtys sp. (juv)</u>	0.26	0.89	1.15	0.51	3.48	1.12	0.08	0.41
<u>Phyllodoce groenlandica</u>	0.26	0	5.86	0.19	0	5.91	9.13	1.21
<u>Polydora caulleryi</u>	0	0.06	0.05	0.01	T	T	0.09	0.05
<u>Potamilla sp</u>	0.76	1.53	5.22	1.02	0.15	2.69	10.31	6.29
<u>Scoloplos armiger</u>	0	0	0	0.05	0.06	T	T	0.06
<u>?Spio filicornis</u>	0	0	0	0.05	0.12	1.21	1.39	1.23
ARTHROPODA - Crustacea	(0)	(T)	(0)	(T)	(T)	(T)	(T)	(T)
<u>Pontoporeia femorata</u>	0	0	0	0	0	0	T	T
<u>Tritella ?pilimana</u>	0	0	0	0.06	T	T	T	T
MOLLUSCA - Pelecypoda	(99.6%)	(96.6%)	(94.5%)	(91.8%)	(97.6%)	(97.4%)	(95.8%)	(97.5%)
<u>Clinocardium nuttallii</u> (adult)	0	0	0	0	47.1	355.9	324.6	26.7
<u>C. nuttallii (juv)</u>	0.51	0.51	2.55	2.55	2.4	4.4	3.1	39.4
<u>Macoma half-hica</u>	547.5	534.7	547.5	382.0	454.6	438.0	409.6	544.5

TAXA	Grams wet weight per m ²							
	6 April				30 July			
	+3.6'	+2.5'	+0.9'	-1.2'	+3.6'	+2.5'	+0.9'	-1.2'
<u>Mya arenaria</u>	3565.1	2164.5	0	178.3	2680.2	2421.7	1199.8	1089.2
<u>M. priapus</u>	0	165.5	25.5	0.38	117.3	119.6	1072.5	1059.8
<u>M. truncatus</u>	0	0	0	343.8	0	0	501.1	662.6
<u>Mya spp. (juv.)</u>	1.02	8.91	8.9	14.01	2.4	6.4	30.8	39.8
<u>Mya spp. (frags)</u>	38.2	10.19	497.8	0	127.3	757.1	1162.4	29.2
<u>Pseudopythina sp</u>	0.76	4.33	1.78	0.89	5.3	7.5	10.4	3.2

Size Class	Frequency				Overall	
	<u>+3.6'</u>	<u>-t-2.5'</u>	<u>+0.9'</u>	<u>-1.2'</u>	f	%
0.0 - 0.9			1		1	0.07
1.0 - 1.9	3	2	1	1	7	0.5
2.0 - 2.9	60	34	44	19	157	11.2
3.0 - 3.9	66	52	97	57	272	19.4
4.0 - 4.9	43	32	73	64	212	15.1
5.0 - 5.9	13	6	28	47	94	6.7
6.0 - 6.9	11	7	11	10	39	2.8
7.0 - 7.9	4	4	5	6	19	1.4
8.0 - 8.9	10	9	11	3	33	2.4
9.0 - 9.9	21	21	9	9	60	4.3
10.0 - 10.9	33	53	35	27	148	10.6
11.0 - 11.9	25	36	42	29	132	9.4
12.0 - 12.9	34	30	17	18	99	7.1
13.0 - 13.9	24	14	30	13	81	5.8
14.0 - 14.9	9	9	10	1	29	2.1
15.0 - 15.9	3	4	3		10	0.7
16.0 - 16.9	3	2	1		6	0.4
17.0 - 17.9			1		1	0.07
<u>n</u>	362	315	419	304	1400	
<u>x</u>	7.31	8.10	6.96	6.74	7.26	
<u>s</u>	4.23	4.09	4.03	3.51	4.02	

APPENDIX Xb .

SHELL LENGTH (MM) DATA FOR MACOMA BALTHICA FROM
GLACIER SPIT, CHINITNA BAY ON 30 JULY 1977

Size Class	Frequency				Overall	
	+3.6'	+2.5'	+0.9'	-1.2'	f	%
2.0 - 2.9	2	4	5	4	15	1.9
3.0 - 3.9	2	8	7	6	23	2.9
4.0 - 4.9	2	4	5	3	14	1.8
5.0 - 5.9	7	11	10	3	31	3.9
6.0 - 6.9	10	20	18	12	60	7.5
7.0 - 7.9	27	18	43	25	113	14.2
8.0 - 8.9	19	12	22	56	109	13.7
9.0 - 9.9	12	6	11	42	71	8.9
10.0 - 10.9	6	15	7	9	37	4.7
11.0 - 11.9	19	32	19	16	86	10.8
12.0 - 12.9	22	29	20	24	95	11.9
13.0 - 13.9	22	17	12	22	73	9.2
14.0 - 14.9	11	9	12	11	43	5.4
15.0 - 15.9	5	3	8	4	20	2.5
16.0 - 16.9	3			1	4	0.5
17.0 - 17.9		1			1	0.1
n	169	189	199	238	795	
\bar{x}	9.28	8.92	9.33	9.73	9.76	
s	3.19	3.37	3.25	2.83	3.16	

APPENDIX Xd.

SHELL LENGTH AND WEIGHT MEASUREMENTS FOR MYA ARENARIA AT GLACIER SPIT,
CHINITNA BAY

+3.6'			+2.5'			+0.9'			-1.2'		
Shell Length (mm)	Whole Wet Weight (g)	Wet Tissue Weight (g)	Shell Length (mm)	Whole Wet Weight (g)	Wet Tissue Weight (g)	Shell Length (mm)	Whole Wet Weight (g)	Wet Tissue Weight (g)	Shell Length (x'nd)	Whole Wet Weight (g)	Wet Tissue Weight (g)
6 April 1977											
90.5	55.00	21.31	56.9	9.86	4.19				27.0	0.99	0.51
93.3	62.84	25.54		39.20	14.23					11.15	5.66
58.7	12.25	6.02	49.3	7.17	3.63				24.3	0.68	0.35
56.6	11.86	5.97	97.7	51.61	20.41						
91.3	52.77	19.56									
97.8	71.07	25.43									
60.4	14.22	6.50									
Average shell length ($\bar{x} \pm s$) = 67.0 ± 26.6											
Wet tissue weight: whole wet weight ratio = 0.40											
30 July 1977											
107.2	67.95	25.81	60.5"	13.06	5.87	64.0	20.80	9.83	100.8	85.56	32.41
59.6	9.0	6.78		19.35	6.15	80.0	39.16	17.99			
88.8	54.77	21.61	47.9	8.05	4.00	56.9	23.00	6.82			
	60.60	23.73	95.7	81.07	27.80	57.0	11.29	5.08			
65.8	18.17	9.91		68.66	28.0						
Average shell length ($\bar{x} \pm s$) = 73.7 ± 19.9											
Wet Tissue weight:whole wet weight ratio = 0.40											

APPENDIX Xe. SHELL LENGTH AND WEIGHT MEASUREMENTS FOR MYA PRIAPUS AT GLACIER SPIT,
CHINITNA BAY

+3.6'			+2.5'			+0.9'			-1.2'		
Shell Length (mm)	Whole Wet Weight (g)	Wet Tissue Weight (g)	Shell Length (mm)	Whole Wet Weight (g)	Wet Tissue Weight (g)	Shell Length (mm)	Whole Wet Weight (g)	Wet Tissue Weight (g)	Shell Length (l-nil)	Whole Wet Weight (g)	Wet Tissue Weight (g)

6 April 1977

42.2	7.05	2.85	31.2	2.37	1.07	7.3	0.03	-
	6.10	2.69						

Average shell length ($\bar{x} \pm s$) = 26.9 ± 17.8
Wet tissue weight:whole wet weight ratio = 0.43

30 July 1977

22.1	1.94	0.91	46.0	9.39	3.66	62.8	19.89	11.41	59.1	23.70	9.16
42.3	7.27	3.44					23.44	7.44	60.4	24.38	9.92
						53.9	17.77	7.42	25.0	1.09	0.57
						54.8	17.78	7.65	61.3	19.48	8.12
						35.7	3.91	1.64	53.9	14.60	5.36
						27.5	1.44	0.71			

Average shell length ($\bar{x} \pm s$) = 46.5 ± 14.6
Wet tissue weight:whole wet weight ratio = 0.42

APPENDIX Xf. SHELL LENGTH AND WEIGHT MEASUREMENTS FOR MYA TRUNCATA AT GLACIER SPIT,
CHINITNA BAY

+3.6'			+2.5'			+0.9'			-1.2'		
Shell Length (mm)	Whole Wet Weight (g)	Wet Tissue Weight (g)	Shell Length (mm)	Whole Wet Weight (g)	Wet Tissue Weight (g)	Shell Length (mm)	Whole Wet Weight (g)	Wet Tissue Weight (g)	Shell Length (mm)	Whole Wet Weight (g)	Wet Tissue Weight (g)
6 April 1977											
			19.6	0.60	-				63.3	24.34"	8.57
30 July 1977											
						14.75	8.16			17.47	13.70
						13.87	7.82		54.6	34.58	16.39
						10.74	4.91				

Wet tissue weight:whole wet weight ratio.= 0.44

SHELL LENGTH (MM) DATA FOR CLINOCARDIUM NUTTALLII
FROM GLACIER SPIT, CHINITNA BAY

6 April 1977				30 July 1977				Frequency		
+3.6'	+2.5'	+0.9'	-1.2'	+3.6'	+2.5'	+0.9'	-1.2'	Size Class	4/6/77	7/30/77
2.0	1.6	9.2	1.9	9.6	1.8	8.7	9.6	1-3	62	16
1.5	2.1	2.5	2.6	2.3	11.5	2.3	3.4	4-6	0	2
2.0	2.4	10.8	2.1	27.1	39.9	2.3	7.4	7-9	1	4
1.9	2.8	2.0	2.0		27.9	5.8	3.4	10-12	1	5
1.7		2.1	2.1		31.3	1.6	2.2	13-15	0	1
		1.8	2.2		33.6	2.2	11.8	16-18	0	0
		1.9	1.9			4.0	12.6	19-21	0	0
		2.0	1.9			2.1	12.7	22-24	0	0
		2.0	2.0			1.9	14.0	25-27	0	2
		2.0	1.5			2.2	10.9	28-30	0	0
		1.8	1.6			2.0	1.9	31-33	0	2
		2.0	2.2			2.0	2.3	34-36	0	0
		1.8	2.2			47.2		37-39	0	1
		1.6	2.4					40-42	0	0
		1.8	1.8					43-45	0	0
		1*9	2.2					46-48	0	1
		1.8	2.5							
		2.2	1.8							
		2.3	3.0							
		2.1	2.2							
		1.8	2.4							
		1.6	2.5							
		2.0	1.9							
		1.9	1.9							
		1.7								
		2.2								
		2.1								
		1.8								
		1.7								
		2.4								
		2.3								
\bar{x}	2.25					10.63				
s	1.46					12.25				
n	64					34				

APPENDIX Xh.

SHELL LENGTH AND WEIGHT MEASUREMENTS FOR CLINOCARDIUM NUTTALLII AT
GLACIER SPIT, CHINITNA BAY

+3.6'			+2.5'			+0.9'			-1.2'		
Shell Length (mm)	Whole Wet Weight (g)	Wet Tissue Weight (g)	Shell Length (mm)	Whole Wet Weight (g)	Wet Tissue Weight (g)	Shell Length (mm)	Whole Wet Weight (g)	Wet Tissue Weight (g)	Shell Length (mm)	Whole Wet Weight (g)	Wet Tissue Weight (g)
6 April 1977											
2.0	0.005	-	1.6	0.002	-	9.2	0.1	-	1.9	0.004	-
			2.1	0.01	-				1.9	0.004	-
			2.4	0.01	-						
			2.8	0.01	-						
30 July 1977											
9.6	0.18	-	1.8	0.005	-	8.7	0.15	-	2.2	0.005	-
2.3	0.01	-	11.5	0.34	-	2.0	0.005	-	11.8	0.44	-
27.1	3.70	0.96	39.9	9.83	3.0	47.2	25.50	9.73	1.9	0.005	-
			27.9	3.32	1.30				2.3	0.005	-
			31.3	7.01	2.23				2.10		-
			33.6	7.79	2.49						

Wet tissue weight:whole wet weight ratio = 0.34

628

APPENDIX Xi. SHELL LENGTH (MM) DATA FOR PSEUDOPYTHINA **SP. FROM** GLACIER SPIT, CHINITNA BAY

6 April 1977						30 July 1977					
+3.6'	+2.5'	+0.9'	-1.2'	Size Class	Number	i-3.6'	+2.5'	+0.9'	-1.2'	Size Class	Number
1.5	3.6	1.9	3.8	1.0-1.9	8	12.9	11.9	2.5	3.3	1.0-1.9	0
1.7	1.9	2.1	4.9	2.0-2.9	16	11.2	2.7	2.3	3.5	2.0-2.9	11
2.5	3.4	2.1	2.0	3.0-3.9	13	2.7	3.0	4.2	3.8	3.0-3.9	12
2.4	4.7	2.0	3.3	4.0-4.9	10	4.4	4.3	3.3	4.4	4.0-4.9	10
4.1	3.7	2.9	4.0	5.0-5.9	0	2.9	4.2	2.4	4.6	5.0-5.9	1
3.5	4.2	3.4		6.0-6.9	0	2.9	6.1	4.3	3.9	6.0-6.9	2
3.4	2.6	2.7		7.0-7.9	0	3.3	3.6	4.0	5.4	7.0-7.9	0
2.9	3.7	4.7		8.0-8.9	0		11.7	4.0	3.7	8.0-8.9	1
1.8	2.4	3.8		9.0-9.9	0		6.7	3.8	2.0	9.0-9.9	1
	2.7	3.0		10.0-10.9	0			9.2	10.0	10.0-10.9	1
	11.9	1.7		11.0-11.9	1			4.5	2.1	11.0-11.9	3
	1.8	2.0		12.0-12.9	0			2.1		12.0-12.9	1
	4.1	2.0		13.0-13.9	0			3.1		13.0-13.9	0
	4.2	2.8		14.0-14.9	0			16.2		14.0-14.9	0
	2.2	4.3						2.0		15.0-15.9	0
	1.6	3.4						3.7		16.0-16.9	1
		3.2						8.9			
		4.4									
\bar{x}	3.18					5.04					
s	1.60					3.37					
n	48					44					

629